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Modern in the Mountains: An Analysis of the Structural and Decorative Concrete at Jackson Lake Lodge in Grand Teton National Park, WY

Julianne Wiesner-Chianese
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Modern in the Mountains: An Analysis of the Structural and Decorative Concrete at Jackson Lake Lodge in Grand Teton National Park, WY

Abstract

This research examines the use of concrete as an expressive structural material in the last work of Gilbert Stanley Underwood at Jackson Lake Lodge, which was completed in 1955, and identifies a strategy for its conservation and overall preservation. As the primary building material at Jackson Lake Lodge, concrete was used not only structurally but also treated decoratively as the exposed surface finish. A discussion of the concrete and its finish includes: structural concrete practices as described in trade journals, building standards, and similar publications contemporary with Jackson Lake Lodge (post-WWII); historic finish treatments for concrete in comparison with “Shadowood”; and acid staining: its use, composition, and application procedure. In addition to extensive archival research, instrumental analysis of concrete samples, with and without finish treatment, was performed using optical microscopy, ESEM/EDS, and XRF. Analysis of the resulting spectra informed a characterization of the historic acid stain, which were compared with spectra for modern acid stains produced by the same company that supplied the stains in 1955. A preliminary condition survey was conducted onsite to verify performance and deterioration of the concrete and acid stain finish.

A conservation program is necessary for the continued preservation of the Lodge, in this case, the character-defining aspect of the exterior, namely the “Shadowood” concrete. Based on the research and analysis performed, it is recommended that successive coloring campaigns and restoration work consider the original design intention and allow for the application of appropriate repair materials without compromising the material or its aesthetic.

Keywords

international style, architectural concrete, board-marked, SEM/EDS, XRF

Disciplines

Environmental Design | Historic Preservation and Conservation

Comments

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MODERN IN THE MOUNTAINS: AN ANALYSIS OF THE STRUCTURAL AND DECORATIVE
CONCRETE AT JACKSON LAKE LODGE IN GRAND TETON NATIONAL PARK, WY

Julianne Wiesner-Chianese

A THESIS

in

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Presented to the Faculties of the University of Pennsylvania
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MASTER OF SCIENCE IN HISTORIC PRESERVATION

2015

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DEDICATION

To my fiancée Paul, my mother Barbara, and my sister Beatrice –

I could not have done this without your love and support.

Thank you!

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First, I would like to thank my advisor, Frank Matero, for introducing me to Jackson Lake Lodge and finding a thesis topic that answered both of my requirements (modern *and* concrete!). Thank you, also, to the large group of wonderful women at the National Park Service and Grand Teton Lodge Company for their guidance, including Betsy Engle, Katherine Wonson, Lori Cornell, Bridgette Guild, and Mary and Holly McKinney. Thanks to Clay James, who patiently answered all of my questions. I'd like to thank Mary Ann Quinn and the staff at the Rockefeller Archive Center in Tarrytown, NY, the staff at the Jackson Hole Historical Society, Virginia Sanchez at Yosemite National Park Archives, and the employees of Epmar Corporation/Quaker Chemical/Kemiko who provided their assistance throughout this project. Finally, I'd like to thank John Hinchman and Nityaa Iyer for all of their support – thank you for keeping me laughing and making sure I wasn't taking myself too seriously.

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Introduction

Overlooking one of the most scenic stretches of the Grand Teton mountain range, Jackson Lake, and the wide, grassy Valley, Jackson Lake Lodge sits on top of Moose Hill, the favorite picnicking spot of John D. Rockefeller, Jr. and his family. As part of Grand Teton National Park, the Lodge is located between the town of Jackson Hole and Yellowstone National Park, but it also stands at the intersection of rustic and modern architecture in the National Parks. At the time of its completion in 1955, the director of the National Park Service, Conrad L. Wirth, was on the verge of launching one of the most comprehensive and ambitious plans in Park Service history. Designed to address the seriously poor and inadequate sanitation and accommodation situation in the Parks resulting from lack of staff and resources following the Great Depression and WWII, Wirth's plan, called Mission 66, was a ten-year-long program to update, upgrade, and reorganize Park administration and architecture. Although Jackson Lake Lodge architect Gilbert Stanley Underwood took this situation into consideration in his design, Mission 66 was not explicitly related to the development at Jackson Lake. Rather, what Underwood created there inspired the direction of subsequent architectural campaigns to take advantage of fast, efficient, and economical modern architecture. This trend was not isolated to the National Parks, as housing shortages elsewhere in the United States also facilitated an increase in the production of concrete structures and modern, International style buildings had been gaining in popularity since the 1930s, but Underwood's use of the material and style at Jackson Lake Lodge represents a unique interpretation of both that was at once traditional and forward-looking.

Although the style and construction of Jackson Lake Lodge are not unique, the architect's treatment of concrete, as structural as well as an expressive, decorative material and its

placement within the context of modern architecture is singular. The signature feature of Jackson Lake Lodge is Shadowood, a special type of board-marked finish that uses sand-blasted strips of plywood in the formwork to leave a raised, woodgrain texture on the surface of the concrete. Board-marked finishes are quite common, and by 1955 were seen as the finished surface decoration of many buildings. All cast-in-place concrete is board-marked unless another material is placed within the formwork to leave a different impression on the concrete as it hardens. Concrete is a carefully proportioned mixture of cement, fine and coarse aggregate, and water. The word concrete comes from Latin and means “to grow together”, which each of these blended ingredients do to form a hard, dense material that bears a similarity to stone. But whereas stone exists fully formed within the earth, concrete has no natural shape. Its form is amorphous, at least until it hardens. This gives it a nearly limitless potential as a structural and artistic medium. Once concrete’s structural capacities were expanded after the introduction of reinforcing iron and steel in the late 19th century, architects began to experiment with concrete’s ability to be molded into nearly any shape. One of the first uses of concrete as a finish material was Frank Lloyd Wright’s Unity Temple in Oak Park, IL (1908) (See Figure 1, Appendix B).¹ Although the surface was later covered with gunite, which is more of an application process of concrete than a finish, Wright intentionally left the marks of the formwork boards on the surface and exposed the internal aggregate to impart an honest, authentic quality to the building. In France, architects such as Auguste Perret and Le Corbusier also embraced the idea of acknowledging the construction process and of taking advantage of the texture and rhythm provided by the regular board-marks on the concrete surface.² Two significant examples

¹ Francis S. Onderdonk, *The Ferro-Concrete Style* (New York: Architectural Book Co., 1928), 9.

² Michael Stratton, *Structure and Style: Conserving Twentieth Century Buildings* (New York: Taylor & Francis, 1997), 214.

include Perret's Church of Notre Dame at Le Raincy (1922-23) and Le Corbusier's Unite d'habitation at Marseilles (1947-52) (See Figures 2 and 3 in Appendix B). In each design, board-marked finishes are ubiquitous, and represent both architects' dedication to using exposed, or "fair-faced", concrete for every surface, decorative or otherwise. What is not always considered or understood about fair-faced concrete is the skill that is involved in designing the formwork so that the concrete can both be structurally sound and be formed with minimal blemishes and repairs. It is a complicated process that demands collaboration between the architect and the contractor.

Board-marked finishes were used in the United States and Scandinavia early in the 20th century but for the former these were mostly found on industrial buildings, such as silos, bridges, and factories, while the latter used them on houses of worship. Japan was also an early proponent of board-marked concrete, exemplified by the work of Wright student Antonin Raymond.³ By the 1930s, modern architecture had come into its own. No longer relegated to the avant-garde, concrete was used for all types of buildings. It was not until the late 1950s, however, that board-marked finishes would take center stage as the preferred surface treatment of Brutalist architecture. Work by Louis Kahn and Paul Rudolph, while quite different stylistically, approached board-marked concrete in similar ways (See Figures 4 and 5 in Appendix B).

In its use of a board-marked finish, Jackson Lake Lodge could be considered an early example of this trend, but the intention behind the Shadowood is more closely related to Underwood's earlier architectural works for the National Parks than to Brutalism.

³ Kurt G.F. Helfrich and William Whitaker, Eds., *Crafting a Modern World: the Architecture and Design of Antonin and Noemi Raymond* (New York: Princeton Architectural Press, 2006).

Underwood used concrete throughout his career, but in his Park architecture it was always board-marked and colored in shades of brown in simulation of wood. At Jackson Lake Lodge, Underwood's International style design meant that there were few places where structural concrete could be mistaken for structural wooden timbers. The Shadowood references Underwood's own traditional rustic architecture in a modern interpretation that also blends into the wooded hilltop on which the Lodge sits.

A recognition of the importance of the design of the Lodge as a catalyst for the changes in Park architecture, as well as its designation as a National Historic Landmark, prompted the commission of a Historic Structures Report with the aim of preparing documentation to support guidelines for restoration and maintenance. The aim of this thesis was to investigate the construction methods and materials used at Jackson Lake Lodge through archival research, an onsite condition survey, and instrumental analysis of samples. These findings will inform the preparation of recommendations for a conservation program and will contribute to the first, documentation phase of the Historic Structures Report.

Literature Review

In the valley beneath the imposing shadows of the Grand Teton mountain range, Jackson Lake Lodge sits overlooking the glassy surface of Jackson Lake. From the lake, the Lodge appears long and low, rising like a small hill among the trees, its matte, red-brown color reminiscent of Sequoias and iron-rich rocks of the American desert. This bucolic and peaceful setting belies the challenging circumstances by which the Lodge came to be constructed and how it was received by the public following its completion in 1955. While much was written in reaction to its construction in the 1950s, as well as to the construction of the Park buildings that followed, the details of the construction of the Lodge have not been discussed at length. A thesis by Betsy Engle (nee Flint) in 2009 chronicled the history of the Lodge from the creation of Grand Teton National Park to the dedication ceremony in June of 1955 and relied heavily on primary documents such as correspondence between key players such as Laurance Rockefeller, Horace Albright, Harold Fabian, and the architect, Gilbert Stanley Underwood.⁴ In *Mission 66: Modernism and the National Park Dilemma* Ethan Carr highlights the significance of Jackson Lake Lodge within the context of Mission 66 and its reliance on modern architectural styles to further the goals of the new plans for the management and operation of the National Parks from 1956 to 1966.⁵ A discussion of Jackson Lake Lodge's embodiment of the dramatic shift in Park management and the stark contrast it presents to the "traditional" Park architectural aesthetic has yet to be examined more closely. As a former Park architect, Gilbert Stanley Underwood designed some of the most beloved lodges within the Park system, including the Ahwahnee Hotel in Yosemite

⁴ Betsy Engle, *"Beneath the Jagged Tetons": Gilbert Stanley Underwood and the Architecture of Jackson Lake Lodge*, Thesis, (University of Virginia, 2009).

⁵ Ethan Carr, *Mission 66: Modernism and the National Park Dilemma*, (Amherst: University of Massachusetts Press, 2007).

National Park and Grand Canyon Lodge. For many visitors, his lodges are some of the most picturesque, defining the landscape nearly as much as the natural surroundings. On his return (actually coming out of retirement for the project), Underwood could have designed another monument to nature and the “Old West”. Instead, he made very deliberate choices about materials, structure, and aesthetics that for many who were so fond of his earlier structures was quite shocking (even Underwood’s biographer sounds disappointed). For Underwood, it appears that at Jackson Lake Lodge practicality was the priority – use of fire-proof, economical materials such as concrete and a return to an International Style-influenced design that rejected excessive ornamentation brought the National Parks firmly into the modern age. Economy and fire prevention had been the motivations behind Underwood’s use of concrete in his earlier Rustic lodge structures, where he chose to leave the concrete exposed but disguised as massive wooden logs, as was the case at the Ahwahnee Hotel completed in 1927. Cost of materials and the risk of devastating forest fires were of constant concern in the remoteness of the National Parks, as was ease of transportation, availability of labor, and a short period of construction limited to summer when reliable fair weather could be expected. Although concrete is a man-made material not found in nature, unlike the timber and stone also used throughout the Ahwahnee, it can be prepared relatively easily and cheaply and can be molded into nearly any shape and take on a wide variety of textures and finishes. Underwood’s use of concrete, and particularly his treatment as a decorative finish material, is the focus of this thesis as well as the broader discussion of the treatment of concrete in architecture.

Concrete has been used for thousands of years as a cost effective alternative to stone. After its rediscovery in the mid-18th century, its promotion and use as an imitation of stone was common but more often it was used as a foundation or structural material and covered with

a veneer of another material, such as terra-cotta or stone. This changed radically in the early 20th century with the experimentations and designs of J.J. Earley and his studio. In addition to his research on how to improve the properties of concrete as a structural material, Earley championed concrete as a versatile, sculptural, and beautiful material. While the majority of his use of concrete as an expressive decorative finish material was accomplished by exploiting the variegated color and texture of the aggregates, Earley's writings were highly influential and inspired others working with concrete to explore its decorative potential.⁶ In addition to exposed aggregate concrete finishes pioneered by J.J. Earley, other decorative treatments of concrete are outlined in J. Gilchrist Wilson's *Exposed Concrete Finishes* of 1964 and include textured and smooth finishes, tooling, painting, the application of renders, and "board-marked finishes".⁷ This last was favored by Gilbert Stanley Underwood and used in three of the hotels he designed: the Ahwahnee, Sun Valley, and Jackson Lake Lodge.⁸ Specifically, Underwood used the texture of the wood used to build the forms in which the concrete was cast to create a pattern of wood grain on the concrete's surface. The concrete was then stained to look like the wood used to create the pattern. At the Ahwahnee and Sun Valley hotels, the wood grain-patterned concrete was intended to blend-in with the real wood and stone used throughout the structure. At Jackson Lake Lodge, however, the use of this technique, which Underwood called "Shadowood", was less about imitating natural, structural materials than it was about creating a surface finish that would reference the Lodge's surroundings and situate it within its natural setting. The use of the texture of the wood formwork to provide a pattern and decorative surface on concrete was used

⁶ Jenna Cellini, *The Development of Precast Exposed Aggregate Concrete Cladding: The Legacy of John J. Earley and the Implications for Preservation Philosophy*, Thesis, (University of Pennsylvania, 2008).

⁷ J. Gilchrist Wilson, *Exposed Concrete Finishes*, Volume 1, (NY: John Wiley & Sons, Inc., 1964).

⁸ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture*, (Malibu: Pangloss Press, 1989).

throughout the U.S. and in Switzerland but became more widespread in post-war architecture. At Jackson Lake Lodge, Underwood's use of the "Shadowood" finish confronts an on-going debate about the way architectural concrete should be treated. By 1955, the use of concrete in its bare, "honest" state, that is, looking like concrete and not stone, wood, or any other material, was well-established following several precedents of the International Style in the U.S. designed by its inventors and proponents such as Ludwig Mies van de Rohe, Walter Gropius, Eliel and Eero Saarinen, and Le Corbusier. Interestingly, Underwood made a name for himself as an Art Deco and International Style architect, as seen in his designs for the Wilshire Tower in Los Angeles (the first "modern" building on Miracle Mile), the Los Angeles Federal Courthouse, and the Union Pacific railroad station in Omaha, Nebraska.⁹ In Jackson Lake Lodge, his last commission, he employs the International Style to look to the future of the National Parks while giving a nod to his Rustic past in the use of wood-grained concrete.

The exterior of the Lodge is made up of a grid of rectangular panels of concrete that correspond to the size of each section of formwork. This creates the appearance of deliberate joints that reinforce the grid of the windows and subtly refer to the long, low massing of the structure. To further emphasize the wood-like quality of the concrete surface and to relate the building to its surroundings, Underwood chose to use a combination of tones of acid stain to color the concrete. By itself, concrete is ordinarily a drab grey color. Depending of the type of sand and aggregate used, it can take on a range of subtle colors. Colorizing concrete is more frequently accomplished using the composition of the sand and aggregates, but the cement can also be pigmented. Painting the concrete is another option.

⁹ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture*, (Malibu: Pangloss Press, 1989), 120-144.

Each of these methods has its limitations, and neither performs well for long periods after being exposed to weathering: further erosion of the exposed aggregate surfaces alters the number and type of aggregates visible on the surface; pigments tend to fade or are not properly mixed and appear inconsistent; paint can accelerate deterioration of the concrete if not applied uniformly or if composed of a mixture that is too impervious. In contrast, acid stains are integral to the concrete and do not erode or fade. If applied improperly they can appear streaky. Acid stains consist of a mixture of hydrochloric acid, inorganic salts, and water.¹⁰ The acid lightly etches the surface of the concrete while a chemical reaction between the salts and the concrete creates the color. An article from the website Concrete Construction claims that Gilbert Stanley Underwood may have been the first architect to use acid staining for “flat-work” or slab or vertical surfaces.¹¹ Despite the increased use of acid staining in residential and commercial construction between the 1920s and 1950s, Underwood still did not trust his contractor’s workmen to apply the acid stain to his satisfaction. In a letter to Harold Fabian, he mentions his plans to carefully supervise the process.¹² Whether the staining was completed as desired is not known, but the result is a warm, matte, red-brown color similar to that of Redwood. This tone was created by combining tan, brown, and black Stone Tone stains by Kemiko and their involvement with the Lodge is still proudly announced on their website’s “history” page, as proof of the quality and durability of their product.¹³

¹⁰ Decorative Concrete Forums, “Acid Stain”, 2010, <http://www.decorativeconcrete.com/content/acid-stain>

¹¹ Joe Nasvik, “Decorative Concrete Comes of Age: Fifty Years of Innovative and Creative People”, September 2006, http://www.concreteconstruction.net/concrete-construction/decorative-concrete-comes-of-age_2.aspx

¹² Rockefeller Archive Center, Gilbert Stanley Underwood Correspondence

¹³ “Kemiko Concrete Stain Bides the Test of Time”, <http://www.kemiko.com/history>

It is the question of durability that prompts the discussion of the preservation and conservation of Jackson Lake Lodge. As a seminal structure, marking a watershed moment in the National Parks, the Lodge has rightly been designated a National Historic Landmark. Its continued use as a hotel and conference center since its completion in 1955 means that maintenance has been regular, but also that many alterations have taken place, especially on the interior, in response to changing standards of hospitality and requirements of guests. A recently completed, preliminary conditions assessment of the concrete has determined that it is sound, with few instances of deterioration except in and around the roof, as is to be expected.¹⁴ Although this preliminary diagnosis is favorable, the question remains of how to approach the repair, restoration, and continued preservation of the unique feature of the Lodge, namely the “Shadowood” and its color. Attempts have already been made to replicate this decorative treatment by the designers of the restaurant addition but they were unable to re-create the appropriate finish and color.¹⁵ This example serves to illustrate the importance of documentation and research of the construction process at Jackson Lake Lodge. This thesis will address the construction process and materials, their properties and pathologies, and make recommendations for their conservation and treatment to support a conservation program.

¹⁴ Jorgensen Associates, PE, “Jackson Lake Lodge, Structural Concrete Condition Assessment”, Project No. 14112.00, August 2014.

¹⁵ Phone conversation with Lori Cornell, Project Manager, Grand Teton Lodge Company, November 14, 2014.

Methodology

Research methodology was organized into three phases: archival research, physical field investigation, and instrumental analysis. Each phase was intended to provide a basis from which a conservation program could be devised. The first phase began with a three-day visit to the Rockefeller Archive Center in Tarrytown, New York, and resulted in the collection of over 200 pages of correspondence and reports, about 100 photographs, and several drawings. Upon returning to Philadelphia, these were organized chronologically and given metadata (author, date, description, etc.) using Adobe Bridge. The contents of the documents were added to an Access database, to facilitate keyword searching and to act as the foundation for an on-going record of maintenance for Jackson Lake Lodge. The correspondence between the key players in the construction of Jackson Lake Lodge, such as Gilbert Stanley Underwood, Harold P. Fabian, Raymond Lillie, and Paul Wise, provided a significant amount of context for the development of all aspects of the Lodge complex. A narrative of the building construction chronology was assembled based on this information and on what was reflected in the various drawing sets.

Once a general history of the building and a timeline of its construction were complete, the drawings and letters were analyzed for detailed information about how the concrete was treated as a structural and decorative material. This included an examination of the specifications for procedures and requirements for creating the Shadowood finish on the concrete which was supplemented by research on construction practices and treatments for decorative concrete.

In March, 2015, a visit was made to Jackson Hole, Wyoming, during which additional archival research was conducted, as well as a condition assessment of the Lodge exterior.

Research performed at the Jackson Hole Historical Society and the Grand Teton National Park Archives resulted primarily in additional images of the Lodge under construction, but also in correspondence that provided further context for Lodge operations and changes made to the building within the past fifty years. At Jackson Lake Lodge, the condition assessment was limited to the exterior of the Lodge. Access to certain areas was also limited due to a large amount of snow around the building. Areas not easily reached from the ground were not examined. No ladders or scaffolding were used to observe conditions on upper stories, but binoculars were employed when necessary. Samples of both the concrete and the acid stain were procured for use in instrumental analysis.

In order to examine the concrete and acid stain finish using optical microscopy, a petrographic thin section was made from a sample of concrete located on the first story balcony leading to the sun deck on the south side of the east elevation. This thin section was examined at varying magnifications for evidence of the surface coating and for general characterization of the concrete matrix. X-Ray Fluorescence Spectrometry (XRF) was performed on samples of both the original acid stained concrete and concrete with the current coating to examine their composition. The resulting spectra were compared with samples of stained concrete and acid stain solutions provided by Kemiko Concrete Products, Inc., the same company that supplied the acid stains for Jackson Lake Lodge in 1955. Samples of the same colors used at the Lodge were requested and used as a standard with which to compare the samples from the site visit. Supplemental analysis was provided by Energy Dispersive Spectroscopy (EDS), which was used to create an elemental map of a cross-section of the original acid stained concrete sample. This was analyzed to provide additional characterization of the acid stain and, to a lesser degree, of the concrete matrix.

Each phase of this methodology provided either historical background or new information about the construction of Jackson Lake Lodge, the design and construction of its character-defining feature, Shadowood, the composition and performance of the structural concrete, and a characterization of the acid staining used to color the decorative, architectural concrete. This information was used to prepare recommendations for the conservation philosophy and future restoration treatment of Jackson Lake Lodge outlined in the conclusion of this paper.

Chapter 1 - Modern in the Making:

Gilbert Stanley Underwood and the Development of Jackson Lake Lodge

1.1 General Building Description

The Central Lodge at Jackson Lake Lodge is a large, three-storey hotel and conference center that was originally designed with 46 guest rooms, a formal dining room, a coffee shop, and a conference room with seating for 600 people (Figure 1). Additional accommodation was available in the form of groups of guest cottages that flank each side of the Central Lodge. Despite its size, about 350 by 150 feet, the lodge sits long and low on a hill overlooking Jackson Lake Valley and the Grand Teton mountain range (Figure 2). Designed in the International style, the building features groups of rectilinear boxes, flat shed and deeply cantilevered roofs, and rows of ribbon windows. The term “International style” was coined by Henry Russell-Hitchcock and Philip Johnson in their 1932 exhibition of modern architecture at the Museum of Modern Art, in which they proposed that buildings that could not be attributed to a specific culture based solely on their decoration made them universal, and hence “International”. This style of architecture is characterized by the use of straight lines, simple rectangular forms, cantilevered projections, open plan interior spaces, bands of windows, and a lack of ornamentation and historical reference. It is often considered synonymous with Modern architecture due to its use of industrial building materials such as steel, glass, and reinforced concrete. At Jackson Lake Lodge, which was built twenty years after the exhibition at MoMA, Underwood employed the features of the International style to provide open spaces and expanses of windows from which visitors could experience the grandeur of the Grand Teton mountain range.

The long, rectangular elevations and bands of windows project a strong sense of horizontality that is reinforced by a subtle grid pattern created by the divided lights of the windows (now changed) and the deep horizontal and vertical V-joints on the surface of the walls. In addition to acting as expansion joints, the V-joints create an overall grid of square and rectangular panels of varying dimensions across the surface of the exterior concrete, which was given the appearance of wood by casting it against strips of highly figured plywood. This treatment, which Underwood called Shadowwood, was intended to make the concrete look like it was made of redwood, providing a visual connection between the structure and its placement on a wooded hilltop. Although Underwood had used this treatment of concrete before in his designs for the Ahwahnee Hotel in Yosemite National Park and the Sun Valley Lodge ski resort in Idaho, at Jackson Lake Lodge the use of Shadowwood is a more stylized version that eliminates the outlines of individual wooden boards seen in other examples of this type of board-marked surface finish. To complete the effect of the appearance of wood, the concrete was colored with acid stains in a light reddish-brown, highlighted with darker brown and black. The translucent quality of the stains and their layered application made the color appear to come from within the concrete, resulting in a very realistic imitation of wood (Figure 3).



Figure 1: Jackson Lake Lodge, east elevation, circa 1956. Credit: Rockefeller Archive Center.



Figure 2: Jackson Lake Lodge, west elevation, 2014. Credit: Joe Elliott



Figure 3: Molded and stained concrete in imitation of wood, 2015. Credit: Author.

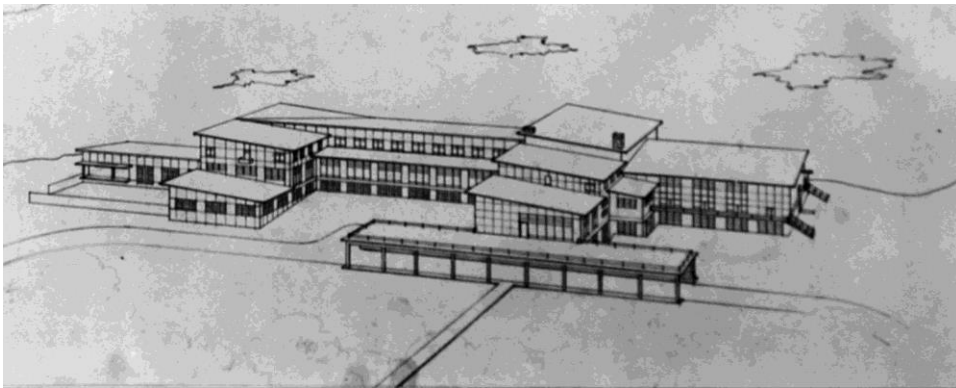


Figure 4: Early rendering of west elevation by Gilbert Stanley Underwood, used here to illustrate grid pattern. Some elements shown in this drawing were not built. Credit: Rockefeller Archive Center.

The Central Lodge is built on a slight rise, so that the ground floor sits just below grade. Overall, it is composed of a series of interlocking rectangular and square blocks that are anchored by a central block of three, stepped squares topped with diagonally-sloping shed roofs (Figure 4). Two rectangular wings extend to the north and south, terminating on the south side in a service yard and the employee dining room, which projects eastward. The east elevation of the lodge is the primary façade of the building and is characterized by a

180-foot wide porte-cochere topped with a sun deck. Visitors enter the lodge from the east, stepping from the drive-through porte-cochere into a low-ceilinged ground floor lobby, containing the check-in desk, newspaper stand, and hotel management offices (Figure 5). Originally, the lobby also housed a beauty shop and telephone booths (Figure 6).

Straight ahead of the doors in the lobby is a central staircase that leads to the first floor, on which the main lounge, dining room, coffee shop, conference room, bar and retail shops are located. This staircase sets the stage for the dramatic presentation of the view of the Grand Teton mountain range in the main lounge, framed by a trio of 60-foot picture windows. This device of drawing people through a smaller, darker space towards a grand open room with astonishing views was something for which Underwood was well-known. It is an enduring feature of the lodges he designed in the 1920s, such as Zion and Bryce Canyon Lodges and the Ahwahnee Hotel. He used it again in 1938 at Sun Valley Lodge in Idaho, where visitors were surprised by the sight of figure skaters through the expansive windows in the lobby. At Jackson Lake Lodge, the main lounge is cavernous compared with the ground floor lobby, and the view of the “Cathedral Group”¹⁶ of three peaks of the Teton Range through the tripartite windows draws entranced visitors into the space (Figures 7, 8).

¹⁶ Harvey H. Kaiser, *Landmarks in the Landscape: Historic Architecture in the National Parks of the West* (San Francisco: Chronicle Books, 1997), 165.



Figure 5: Lower Lobby, 2014. Credit: Joe Elliott.



Figure 6: Lower Lobby, circa 1957. Note the enclosures to the right and left housing office and the Beauty Parlor, respectively. Credit: Grand Teton National Park.

The large bank of windows at the west end of the main lounge projects slightly into the landscape, providing sweeping views of the mountains from three sides (Figure 9). Here, visitors can exit the lounge and make their way onto the patio directly in front of the windows or they can walk north towards the favorite picnicking spot of the Rockefeller family, known as Lunch Tree Hill. Seen from the top of this hill or from a boat on Jackson Lake, the lodge blends into the scenery, a remarkable feat for such a large structure but a critical element of Underwood's design. It appears to rise out of the landscape, growing from the top of the hill as naturally as the surrounding trees. The west elevation presents the best illustration of the horizontal grid pattern of Underwood's design: a clear, simple expanse of which the windows are a defining element (Figure 10). The horizontal lines of the sills, lintels, and muntins of the windows on each storey are continued, visually, by the deep V-joints that define the concrete panels. Vertical joints complete the grid pattern but do not extend from all the corners of the windows; some lie in-between them. With an entire façade made up essentially of all windows, the west elevation acts like a viewing platform with every opening angled to take advantage of the magnificent view.



Figure 7: Upper Lobby/Main Lounge, 2014. Credit: Joe Elliott.



Figure 8: Upper Lobby/Main Lounge, circa 1956. Credit: Jackson Hole Historical Society.



Figure 9: Postcard of west elevation, circa 1956. Credit: Rockefeller Archive Center.



Figure 10: West elevation circa 1956 showing strong horizontality. Credit: Grand Teton Lodge Company.

The north and south elevations of Jackson Lake Lodge are primarily service-oriented spaces, with the north terminating in the conference room and the south housing the aforementioned employee dining room, maintenance shops, and service yard (Figure 11). The special Shadowood treated concrete was not used in the service area. The walls surrounding the yard display a board-marked finish more commonly seen in concrete construction. This was also acid stained, but because it was a non-public space it could be built without the decorative surface treatment of the rest of the structure. This lack of decoration is continued on the interior of the service and back-of-house areas, which is in stark contrast to the rest of the building. Nearly all of the interior public spaces were given the same Shadowood finish as the exterior, but instead of another material being formed to take on the appearance of wood, actual plywood of varying species was used on the walls. The exterior panels were formed exclusively against redwood plywood, but on the interior Douglas fir and hemlock were more common. The use of wood throughout the building referenced the heavy use of timber framing in the rustic lodges and log cabins of the early 20th century architecture in the National Parks, some of which Underwood had designed. However, instead of using log construction, the wooden elements are reduced to flattened figured surfaces that conform to the regular, geometric lines of the International style. This gridded surface connected inside and out even if the materials themselves changed. There was one space in the lodge that had a more traditional connection with the rustic genre prevalent in earlier lodges. The Stockade Bar (Figure 12), located on the first floor and leading out onto the sun deck over the porte-cochere, was intended to be a recreation of Fort Laramie, a fur trading outpost built in 1834 that became the “largest and best known

military post on the Northern Plains”¹⁷. With log-clad walls, hunting and trapping accessories, and a mural and dioramas of a historic fur trapping scenes on the walls, the bar playfully celebrated the history of Jackson Hole and the American west. The Central Lodge at Jackson Lake Lodge represents the intersection of the rustic architecture of the National Parks of the 1920s with the modernist, motor-court style of the automobile-age. In his design, Gilbert Stanley Underwood adopted the clean and direct geometric massing of the International style to insert a large building unobtrusively into the landscape. Long rectangles, bands of fenestration, and a grid pattern formed in the exterior concrete emphasized the horizontality of the hill on which the lodge was placed.

Underwood’s ability to create a bold, modern design that remained sensitive and responsive to the surrounding landscape was a hallmark of his work in the National Parks. It was this ability that convinced John D. Rockefeller, Jr. to select Underwood as the architect to design the hotel that would frame and preserve a view that was “very near to his heart”.¹⁸ At the same time, another plan for preservation of the natural resources of the National Parks was also being designed. Jackson Lake Lodge would play a large role in the aesthetic program of Mission 66, a Park Service-led initiative to provide improved accommodations and access to the Parks for the American public.

¹⁷ National Park Service, “Fort Laramie: National Historic Site, Wyoming”, website of the National Park Service, <http://www.nps.gov/fola/index.htm>.

¹⁸ Laurance S. Rockefeller. “Jackson Lake Lodge Dedication.” June 11, 1955. Folder 836, Box 91, Cultural Interest Series, Record Group 2, Office of Messrs. Rockefeller, Rockefeller Family Archives, RAC.



Figure 11: Detail of service yard walls with regular board-marked finish. Notice horizontal boards along soffit on the left. Credit: Jackson Hole Historical Society.



Figure 12: Stockade Bar, circa 1956. Credit: Rockefeller Archive Center.

1.2 Site History

Jackson Lake Lodge was designed as a modern, forward-looking building that served as the precedent for a new direction in the management and architecture of the National Parks.¹⁹ The impetus for this change was the deplorable conditions of tourist accommodations in the National Parks following increased visitation after World War II.²⁰ Because of reduced funding during the war, the structures built during the first large construction period in the parks in the 1920s and 30s had deteriorated and were no longer suited to support large numbers of people.²¹ This drove many to camp out wherever they could find space, posing a threat to the natural resources the parks had been founded to protect. It also resulted in piles of trash lining the forests and roadsides, and the spread of illnesses from contaminated water sources. These conditions prompted Park Service director Conrad L. Wirth to propose an ambitious, ten-year redevelopment program called Mission 66, which would not only overhaul the park's dilapidated structures but also its organization and management.²² The program would initiate the second largest construction period in the National Parks, adapting modern architectural style to reflect this new, modern image.²³

Although Jackson Lake Lodge was completed prior to the implementation of Mission 66, it was designed with the goals of the program in mind. When John D. Rockefeller, Jr. and the members of the newly-formed Grand Teton Lodge & Transportation Company were forming an idea of how to update the existing accommodations in Jackson Hole, it was Gilbert

¹⁹ This section based on the detailed history of the development of the Mission 66 program written by Ethan Carr. *Mission 66: Modernism and the National Park Dilemma* (Amherst: University of Massachusetts Press, 2007).

²⁰ Ibid, 3.

²¹ Ibid, 4-5.

²² Ibid, 10.

²³ Ibid.

Stanley Underwood who illustrated the need for a new approach. In his proposal for Jackson Lake Lodge he included a detailed description of the challenges faced by the National Parks after many years of operating with a tiny staff and budget²⁴. His solution was to design a modern, motor-court style hotel complex that would provide proper accommodations for the ever-increasing numbers of visitors coming to the Parks (just over one million in 1948²⁵), nearly all of them now arriving predominantly by car. It was exactly this type of accommodation that Wirth had in mind: “a large, centralized building, modernist in its architectural inspiration, with easy highway access, generous parking, and “one-stop” convenience”.²⁶ Taking a cue from the development of post war suburbs and the accompanying commercial hubs, like shopping centers, Jackson Lake Lodge would create a link between the “great outdoors” and the type of all-in-one, centralized source of amenities with which Americans were becoming familiar. In this way, increased density in the National Parks would be addressed in a very similar manner as increased density was addressed in urban areas. Interestingly, Jackson Lake Lodge was designed independently of the Mission 66 program, although Underwood was probably aware of it through his close friendship with Stephen Mather, a former director of the National Park Service.²⁷ Even though it was not expressly created with the program in mind, Jackson Lake Lodge’s bold design ultimately set the precedent for the modernistic style of architecture that the program would adopt for all of its new buildings.

²⁴ Gilbert Stanley Underwood, “A Scheme for the Development of the Public Concessions in Grand Teton National Park, WY”, December 1, 1950, Folder 831, Box 90, Cultural Interest Series, Record Group III2E, Grand Teton Lodge Company 1953-61, Office of the Messrs. Rockefeller, Rockefeller Archive Center.

²⁵ Ethan Carr, *Mission 66: Modernism and the National Park Dilemma* (Amherst: University of Massachusetts Press, 2007), 4.

²⁶ Ibid, 50.

²⁷ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture* (Malibu: Pangloss Press, 1989), 54-55.

Initially, the development of Jackson Hole and the Jackson Lake Valley was focused on protecting the landscape from those who would try to capitalize on its beauty and location by building tourist traps throughout the area. This was of particular concern for John D. Rockefeller, Jr., who had been visiting the area around Jackson Hole with his family for many years. He was concerned that speculative commercial developments would be threatening to his favorite view of the Grand Tetons. In response, Rockefeller created the Snake River Land Company, through which he purchased lands from private citizens in and around Jackson Hole during the 1920s.²⁸ He then announced that the lands would be donated to the Federal government, with the intention that they would eventually be included in Grand Teton National Park, which was established in 1929 but did not extend to the area around Jackson Hole. A huge controversy and legal battle ensued between Rockefeller and the citizens of Wyoming, from whom he had purchased the land, who claimed that they had been tricked into selling. After ten years the matter was finally resolved, with the verdict being that all those who sold land to Rockefeller's company did so willingly and were given a fair price. Furthermore, the lands in question were designated a National Monument by President Roosevelt in 1943, an action that did not require congressional approval. The Monument was incorporated into Grand Teton National Park in 1950.²⁹

Once the Monument had been established, Rockefeller was satisfied that the threat of commercial development had been addressed and he was no longer interested in being involved in activities in the area. Management of the land and concessions were left up to

²⁸ Ethan Carr, *Mission 66: Modernism and the National Park Dilemma* (Amherst: University of Massachusetts Press, 2007), 129.

²⁹ Ibid, 129.

the Grand Teton Lodge & Transportation Company (GTL&TC), a subsidiary of Jackson Hole Preserve, Inc., which was a non-profit organization founded by Rockefeller. Executive Vice President of the GTL&TC Harold P. Fabian, who was the former head of the Snake River Land Company, saw the opportunity for an expansion of the existing tourist accommodations that existed on the site of the current Jackson Lake Lodge. The Snake River Land Company had purchased the old Jackson Lake Lodge, as well as at the nearby hotels and ranches of Moran, Jenny Lake, and Square G, in the early 1920s.³⁰ These were small operations that catered to tourists taking the stagecoach route to Yellowstone National Park. Old Jackson Lake Lodge, originally called the Amoretti Inn, opened in 1922, and had rooms for about 100 guests as well as a restaurant.³¹ Though still operating and quite popular, old Jackson Lake Lodge and the other hotels nearby were too small to accommodate the increasing number of visitors to the parks. More space was needed, but managing and upgrading each hotel individually would be too expensive. Fabian wanted to convince Rockefeller to fund an entirely new hotel project, but was having difficulty persuading him. Plans were initiated in 1946 and a consulting architect was sought to make preliminary drawings, but Rockefeller changed his mind and backed out of the project. Then, four years later Rockefeller was visiting Jackson Lake Valley with Harold Fabian and some men from the National Park Service. During the visit, one of the men mentioned that he thought the tourist facilities at Moran should be closed and that the buildings should be moved to Jackson Lake Lodge.³² The idea intrigued Rockefeller, who thought the Park

³⁰ Harold P. Fabian to Raymond Lillie, November 9, 1953, Folder 831, Box 90, Cultural Interest Series, Grand Teton Lodge Company, 1953-61, Record Group III2E, Office of the Messers Rockefeller, Rockefeller Archive Center.

³¹ Ibid.

³² Harold P. Fabian to Horace Albright, August 3, 1952, Folder 337, Box 29, Harold P. Fabian Papers, Teton Company, Record Group IV 3A7.2, Rockefeller Archive Center.

Service had no interest in the concessions in Jackson Hole, and he expressed to Fabian his renewed interest in developing Jackson Lake Lodge in partnership with the National Park Service.³³ The search for an architect back in 1946 had resulted in the selection of Gilbert Stanley Underwood, who had recently completed two hotels for Rockefeller at Colonial Williamsburg. Despite Rockefeller's initial loss of interest in the project, Underwood remained undeterred and continued to sketch preliminary plans. After a visit to the site in Jackson, he composed his "Scheme for the Development of the Public Concessions in Grand Teton National Park".³⁴ The plan called for two stages of development. The first considered the option proposed to Rockefeller during his last visit: that existing buildings at Moran would be moved to the old Jackson Lake Lodge where they would be combined to create a larger hotel, restaurant, and campsite. However, it was the second stage, which called for an entirely new, modern hotel complex, which would ultimately win out. Built of "fireproof" reinforced concrete (instead of the wood used for all the old Jackson Lake Lodge buildings), with a full service restaurant, conference room for 600, and huge picture windows that prioritized Rockefeller's favorite view of the Grand Teton mountain range, Jackson Lake Lodge established Grand Teton National Park as a true tourist destination. Fittingly, it was also the last hotel, and last work, of Underwood's career, in which grand hotels for the National Parks had played an important role.

³³ Harold P. Fabian to Horace Albright, August 3, 1952, Folder 337, Box 29, Harold P. Fabian Papers, Teton Company, Record Group IV 3A7.2, Rockefeller Archive Center.

³⁴ Gilbert Stanley Underwood, *A Scheme for the Development of the Public Concessions in Grand Teton National Park, Wyoming*, December 1, 1950, Folder 831, Box 90, Cultural Interest Series, Record Group III2E, Grand Teton Lodge Company 1953-61, Office of the Messrs. Rockefeller, Rockefeller Archive Center.

1.3 The Architect³⁵

Gilbert Stanley Underwood (1890 -1960) was a Yale and Harvard-trained architect whose long career took him to both coasts of the United States and whose clients included the National Park Service, the Union Pacific Railroad, and the United States government. Although his career was highlighted by some major commissions including the Ahwahnee Hotel in Yosemite National Park, the Union Pacific Railroad central terminal and offices in Omaha, Nebraska, and Jackson Lake Lodge in Grand Teton National Park, it was defined by his many designs for small railway stations and post offices. These types of smaller commissions kept him employed almost continuously from just after high school, through his college years, and, importantly, through the Depression. Ultimately, he became Supervising Architect of the Federal government, joining a select group of only 18 others to hold this position. His architectural style ranged from Rustic, to Spanish Revival, to Art Deco and Federal, depending on the surrounding environment and the needs of his clients. This stylistic diversity may be part of the reason why he remains relatively unknown, despite having designed some of the most beloved and recognizable buildings in the National Parks. However, his ability to be flexible in his designs served him well during his career, allowing him to adapt to the many different requirements of his projects. In this way, his frequently changing “signature” style was always in demand.

Born in Oneida, New York in 1890, Gilbert Stanley Underwood grew up in San Bernardino, California. Underwood’s architectural background began fairly early with a position as a draftsman at age eighteen, followed by an apprenticeship with Franklin Burnham (no

³⁵ A single monograph about Gilbert Stanley Underwood exists and provided most of the information for this section. Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture* (Malibu: Pangloss Press, 1989).

relation to Daniel Burnham, of the well-known architecture firm Burnham and Root), and then Arthur Benton, an architect known for designing in the Mission style. In 1911, he worked with Benton and another architect named Arthur Kelly, whose designs were primarily of the Craftsman-style. Underwood's later work demonstrates the strong influence both architects had on the development of his style.³⁶ His formal training began at the University of Illinois in 1912, but he soon married and spent six years traveling the country to find steady employment to support his family. He ultimately enrolled at Yale University in 1920 for his final year of undergraduate study, followed by graduate work at Harvard University between 1921 and 1923. After graduation, Underwood moved his wife and young son to Los Angeles and opened his first office. The early 1920s was a prosperous and exciting time for California, as the population was expanding rapidly, and with it the demand for housing and infrastructure. It was a good time for a young architect to establish a practice.³⁷

Even as California's population and construction was booming, there was no guarantee of steady work. Underwood's office benefitted from his close ties with two men who had great influence over the design and construction of buildings in the National Parks at this time: Stephen Mather, Director of the National Park Service, and Daniel Hull, his assistant. Both were involved in the development of tourist facilities throughout the Parks and knew Underwood through his friend Paul Kiessig, with whom Underwood had worked in Arthur Kelly's office and who had begun working with Hull for the Park Service.³⁸ These connections, in addition to Underwood's experience with designing hotels during the

³⁶ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture* (Malibu: Pangloss Press, 1989), 7-8.

³⁷ Ibid, 10-15.

³⁸ Ibid, 14.

intervening years between his studies at the University of Illinois and Yale, meant he was well placed to be recommended for several projects already under discussion by the time he had moved to Los Angeles in 1923.

Between 1924 and 1928, Underwood designed four lodges for the National Park Service, in collaboration with the Union Pacific Railroad, which would come to define not only his own Rustic style, but also what many visitors would consider some of the most iconic examples of early 20th century National Park architecture. His designs for Zion Lodge (1924), Bryce Lodge (1924), Grand Canyon North Rim (1928), and, especially, the Ahwahnee Hotel (1927), reflected the influence of Northern European alpine lodge styles on Park architecture³⁹, and the desire of the railroad companies to attract wealthy trendsetters to luxury accommodations that offered an alternative to tents and campsites (Figures 13-16). The resulting structures incorporated natural elements from the surrounding landscape, such as stone and heavy timber framing, and capitalized on dramatic presentations of the biggest attraction to the lodges: namely, the sweeping views of the Grand Canyon, Zion and Bryce Canyons, and the cliffs of the valley at the Ahwahnee. While it is arguably impossible to compete with the stunning natural environment in the National Parks, Underwood's elegant lodges became almost as much of an attraction as the landscape itself.

³⁹ As seen in Robert Reamer's design for Old Faithful Lodge in Yellowstone National Park of 1903.



Figure 13: "Tourists leaving Zion Lodge for the Temple of Sinawava and trail trip to Narrows", September 8, 1929. Credit: G. Grant, Record Group 79: Records of the National Park Service, 1785 - 2006, Photographs of the Zion and Bryce Canyon National Parks, 1929, U.S. National Archives and Records Administration, http://commons.wikimedia.org/wiki/File:Tourists_leaving_Zion_Lodge_for_the_Temple_of_Sinawava_and_trail_trip_to_Narrows._-NARA_-_520535.jpg.



Figure 14: Contemporary image of Bryce Canyon Lodge, completed 1924. Credit: en.wikipedia.org.



Figure 15: Contemporary image of Grand Canyon North Rim Lodge. Completed 1928, burned 1932, rebuilt. Credit: www.allgrandcanyon.com.



Figure 16: Undated historic image of the Ahwahnee Hotel. Credit: www.yosemitepark.com.

Although the lodges for the National Parks that Underwood designed in the 1920s could broadly be considered of the Rustic style, Underwood's work over his career is not so easily described. It is not necessarily characterized by any one style, rather, he designed in the style he felt best suited the client's needs. For example, in addition to hotels, Underwood designed many depots and railway stations for the Union Pacific Railroad throughout the country, as well as their home office and station complex in Omaha, Nebraska. He soon became well-known for his work with railroads, so much so that he wrote an article about railway station design for the journal *Architectural Forum* in 1930.⁴⁰ Despite their somewhat formulaic and repetitive layouts, Underwood took care to vary the depot designs, exploring styles such as Spanish Revival (likely influenced by his time working in the office of Arthur Benton), English Tudor, and Art Deco.⁴¹ It was this latter style in particular that came to define some of Underwood's most important commissions in the late 1920s and early 1930s.

Just prior to designing Union Pacific's central terminal station and offices in 1930, Underwood completed the Wilshire Tower Building in Los Angeles in 1928. As the first "modern" building on what would become L.A.'s "Miracle Mile"⁴², the elegant concrete structure with its mid-block tower and curving facade still commands the corner of Wilshire Blvd (Figure 17). The structure Underwood designed for Union Pacific is even more expressive, with a monumental central station terminal entrance flanked by smaller, rectangular wings. Both exterior and interior were highly decorated in the style of

⁴⁰ Gilbert Stanley Underwood, "The Design of Small Railway Stations", *Architectural Forum* 53 (1930), 695-700.

⁴¹ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture* (Malibu: Pangloss Press, 1989), 114-115.

⁴² *Ibid*, 120.

ornament typical of Art Deco, with strong vertical and horizontal elements referencing the speed of the railways as a streamlined mode of transportation (Figure 18). Two more structures that featured elaborate Art Deco interiors came about ten years later, in the forms of the Federal Courthouses of Los Angeles (1938) and Seattle, Washington (1941).

With the beginning of the Great Depression in 1929 came changes for Underwood's architectural practice as well as his architectural style. The Union Pacific station and offices in Omaha was Underwood's last major project before he was forced to close his firm in Los Angeles.⁴³ Most of his staff dispersed, while Underwood sought work with the Federal government. He was very fortunate to find a position as Consulting Architect for the United States, as thousands of other architects struggled to find employment, and by 1934 he and his family had moved to Washington, D.C. During the period from about 1935 to 1941, Underwood was engaged in designing a large number of post offices, as well as the aforementioned courthouses in L.A. and Seattle, and the State Department Building in Washington, D.C.⁴⁴ Despite his interest in and fondness for the elegant and often luxurious ornamentation and materials of the Art Deco style, Underwood's designs for the government became increasingly austere, at least on the exterior. According to his biographer, Joyce Zaitlin, Underwood was strongly influenced by the work of other architects he encountered in Washington: "[Underwood] came to admire other consulting architects like Paul Cret, whose vertical window strips and concern with designing volumes instead of 'decorating surfaces'...set 'both the trend and the standard for "starved

⁴³ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture* (Malibu: Pangloss Press, 1989), 130.

⁴⁴ Ibid, 134.

classicism”,’ which so characterized Underwood’s own Federal architecture”.⁴⁵ However, even these influences did not completely change Underwood’s personal style. He maintained a sophisticated sense of interior design, incorporating light, color, texture, and pattern into his designs. Even the State Department Building in Washington, D.C. received this treatment. Its exterior is made up of large rectangular masses that typify much of the Federal architecture of the Nation’s Capital, and the lobby is decorated with murals.⁴⁶ This holistic approach to design, of considering the needs of the user from both interior and exterior perspectives, is characteristic of Underwood’s work.

In 1947, Underwood was promoted to Supervising Architect of the Federal government.⁴⁷ He remained in this position for two years before retiring from government work. Although his time with the Federal government provided steady income, it did not prevent Underwood from seeking commissions from elsewhere and secretly using members of his staff to complete projects. The fact that this was explicitly listed in his contract as prohibited, as well as being against the law, left Underwood unfazed.⁴⁸ Nor did it occur only towards the end of his career. Within two years of moving to Washington, D.C., Underwood was engaged in another hotel project for Union Pacific Railroad in Idaho, unbeknownst to his superiors in Washington. The Sun Valley Lodge was a luxury ski resort designed to attract the rich and famous.⁴⁹ Underwood designed an x-shaped hotel complex that had more in common with his recent work in the Art Deco style than that of his previous lodges, but he maintained a connection to the European alpine and Rustic aesthetic by forming and

⁴⁵ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture* (Malibu: Pangloss Press, 1989), 139.

⁴⁶ Ibid, 141.

⁴⁷ Ibid, 144.

⁴⁸ Ibid, 149.

⁴⁹ Ibid, 151.

staining the exterior concrete to look like boards of wood (Figure 19). Completed in 1938, ten years after the Ahwahnee in Yosemite National Park, it was immediately followed by a commission for two hotels at Colonial Williamsburg (1939), a project funded by John D. Rockefeller, Jr. These were very well received and placed Underwood once again in a position to take advantage of his National Park Service (and now also Colonial Williamsburg) connections to secure one last commission: Jackson Lake Lodge.



Figure 17: Wilshire Tower, circa 1930s, Los Angeles. Credit: Mott-Merge Collection, California State Library, <https://miraclemilela.files.wordpress.com/2010/10/desmonds-building-circa-1930s.jpg>.

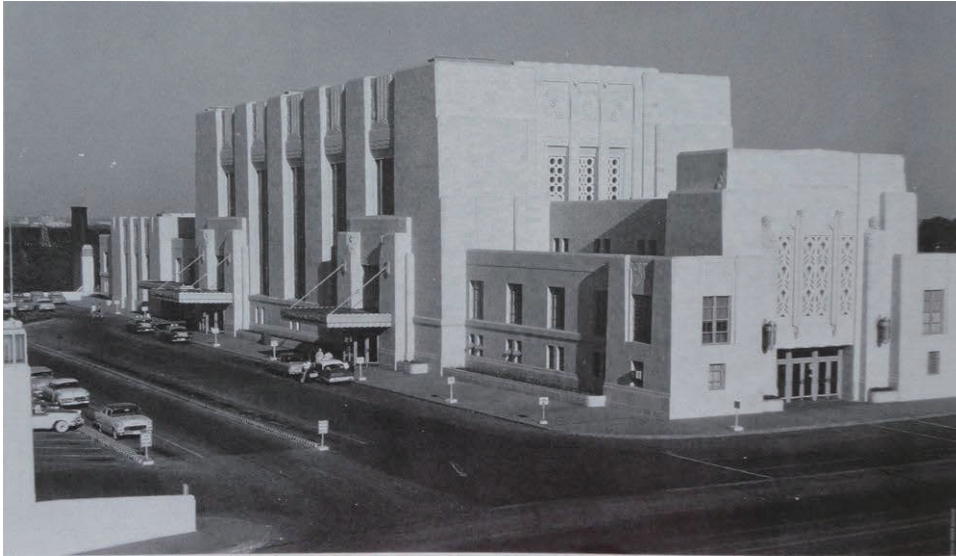


Figure 18: Union Pacific Station, Omaha, Nebraska, circa 1930. Credit: Union Pacific Railroad.



Figure 19: Contemporary image of Sun Valley Lodge, Utah. Credit: www.chuckpalahniuk.net.



Figure 20: Dining room, Sun Valley Lodge. Credit: www.ryereflections.org

1.4 Underwood and Concrete

The most distinctive and character-defining feature of Jackson Lake Lodge is the Shadowood. Underwood used this term to describe his specially-designed form of board-marked finish, which is a decorative surface treatment of concrete. Although Shadowood is a term that is found in advertisements in lumber trade journals of the 1950s^{50,51} its use in reference to concrete has so-far only been found at Jackson Lake Lodge. There, the Shadowood is the final version of a concrete finish that Underwood began using as early as 1927 in his designs for the Ahwahnee Hotel in Yosemite National Park. He used it again in Sun Valley Lodge about ten years later and finally at Jackson Lake Lodge in 1955. These three hotels illustrate the evolution of Shadowood as Underwood honed it over his career.

Gilbert Stanley Underwood was building in concrete early in his practice. The Baltimore Hotel in Los Angeles, which was completed in 1910, is an example of an early concrete building that Underwood collaborated on with Arthur Kelly, his employer at the time.⁵² A postcard from the period announces that the hotel is “Absolutely Fireproof”⁵³, an important feature for an area prone to fires as a result of serious earthquakes (Figure 21). The need for fireproofing was the motivating factor behind constructing the Ahwahnee Hotel of concrete. As the fourth in a series of important commissions from the National Park Service, and the most expensive so far, the design for the Ahwahnee had to meet very high expectations. Although concrete and steel construction was initially considered to be too

⁵⁰ New York Lumber Trade Association, *The New York Lumber Trade Journal*, 1954, Volumes 122-123, xlii, lxviii.

⁵¹ John Rogers, “Shopping for Plywood”, *Popular Science Magazine*, September 1953, 215.

⁵² Ruth Wallach, Linda McCann, et al, “Images of America: Historic Hotels of Los Angeles and Hollywood” (Chicago: Arcadia Publishing, 2008), 64.

<http://www.usc.edu/libraries/subjects/slavic/documents/historichotels.pdf>.

⁵³ Ibid.

expensive⁵⁴, these materials ultimately made up the largest portion of the building, though stone and timber framing were also used.⁵⁵ While concrete and steel are considered to be modern materials that many think of only in reference to current construction practice, the technology is quite old and already had a long history of manufacture and use by the 1920s. In the case of concrete, its development and use for roads, industrial buildings, and even residences had been steadily increasing in England and parts of Europe, particularly France, since the early 19th century. The turn of the twentieth century saw increased use of concrete in the United States, due in part to developments in its local manufacture and improvements in its structural properties. The work of innovators such as J.J. Earley and his Studio, of Le Corbusier in France, and of Frank Lloyd Wright in the U.S. and Japan, helped create value for concrete as a highly flexible, sculptural, and decorative material that could be beautiful in its own right (the use of concrete as a decorative material is explored later in this paper). To what degree Underwood was influenced by these developments in aesthetic concrete is unknown, yet his treatment of the material at the Ahwahnee suggests that he recognized the potential of concrete to be used in creative and innovative ways.

The need for fireproof construction at the Ahwahnee Hotel meant using concrete for the structure was desirable, but it was not a prerequisite for leaving areas of concrete exposed. Underwood could have chosen to cover all structural members with wood and stone, though this would have added significantly to the cost. He also could have chosen to leave the concrete beams exposed but then have them painted or otherwise decorated. Instead, he chose to exploit concrete's sculptural qualities by deliberately making an impression of

⁵⁴ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture* (Malibu: Pangloss Press, 1989), 62.

⁵⁵ Ibid, 71.

the wooden planks used in the construction process on the surface of the concrete.⁵⁶ This directive is included in his specifications, where he wrote: "Special care should be used in placing concrete against exposed [wood] surfaces, since it is the intent of these specifications to produce all exposed surfaces of concrete with the pattern of the rough grain of the wood".⁵⁷ He then took the illusion one step further, coloring the concrete with acid stains that would impart a translucent, integral finish that was varied in the same way as that seen in wooden beams. Again, this was called for in the specifications: "an acid stain similar to Keremic, or equal, [should be used], to be not less than 2 coats".⁵⁸ The resulting finish was a raised woodgrain texture colored to look like redwood. By using this special, board-marked finish the Ahwahnee achieved a rustic appearance, as desired by Underwood's clients and the hotel's clientele, but it was interpreted in a modern way using modern materials (Figure 22).

Underwood took this interpretation further when he designed the Sun Valley Lodge, in Ketchum, Idaho. The hotel was to be as modern as possible, as Underwood's clients were eager to lure wealthy patrons with luxurious accommodations.⁵⁹ In his design, Underwood drew from his more recent work in the Art Deco style, emphasizing horizontals and verticals in his layout of the 250 rooms with bands and stacks of windows. Once again, the design called for concrete construction, even though sources of timber were available nearby.⁶⁰ While fireproofing was again the most likely reason for this specification, the use of concrete gave Underwood the opportunity to use board-marked finishing in yet another

⁵⁶ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture* (Malibu: Pangloss Press, 1989), 73.

⁵⁷ Specifications for the Ahwahnee Hotel (Archives of Yosemite National Park), 29.

⁵⁸ *Ibid*, 20.

⁵⁹ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture* (Malibu: Pangloss Press, 1989), 152.

⁶⁰ *Ibid*, 153.

variation. This time, the imprint of the wooden boards on the concrete was arranged so that it would recall the wooden construction typical of Swiss ski chalets, but in an unmistakably contemporary, and American, interpretation. As at the Ahwahnee, Underwood specified that the concrete be stained to complete the effect of the lodge being constructed of wood. The concrete was formed to give the impression of diagonally, vertically, and horizontally-laid wooden boards on the facade, implying both a structural and decorative application (Figure 23). Sun Valley represents the first intersection between a distinctly modern building style and the reference to rustic lodges of the past in the form of a molded, board-marked and stained concrete finish.

By the time Underwood was commissioned to design Jackson Lake Lodge, the American public had fully embraced concrete as a structural material and was familiar with its use as a decorative surface treatment. Following the Second World War, concrete structures became nearly ubiquitous, as many other building materials were scarce due to wartime rationing, while the raw materials for making concrete were still fairly abundant. It was also cheaper to produce than many other materials, was fairly easy to make, and could be precast into wall panels for faster delivery and assembly. This became all-important during the post-war period, as there was a severe housing shortage across the country and the solution to this problem quickly became concrete.

In this same period, the National Parks were experiencing their own shortage of adequate tourist accommodations. Many were seriously lacking in basic amenities, as well as being ill-equipped to serve the millions of visitors coming to the Parks each year. These issues demanded architecture that could support large numbers of people efficiently while prioritizing modern conveniences such as on-site parking, retail shops, and fine and casual

dining. Underwood greeted this challenge head-on, creating a motor-lodge style complex as a pilot project on which future Park accommodations could be based.⁶¹

It was at Jackson Lake Lodge that the style of board-marked finish that Underwood had been developing since his work at the Ahwahnee came to full maturity. The board-marked finishes seen at the Ahwahnee and Sun Valley Lodge were created as part of the construction process. When concrete is cast-in-place, forms are built out of wood to hold the mixture while it cures, and hardens. Concrete has no shape of its own, so it will retain the imprint of whatever material against which it is formed. If nothing is placed between the formwork and the concrete paste, the concrete will have the impression of the boards used to build the forms after they are removed. Many different surface textures can be achieved by placing various materials between the forms and the concrete mixture (these are discussed in the section about concrete finishes).

At Jackson Lake Lodge, thin strips of sand-blasted plywood were placed between the formwork and the concrete mixture in a highly controlled manner, leaving an impression of woodgrain on the surface of the concrete (Figure 24). Although the woodgrain texture was also deliberately left on the surface of the concrete at the Ahwahnee and Sun Valley, Underwood made no changes to the dimensions of the boards used in the formwork. The plywood used at Jackson Lake Lodge, however, was made up of strips of specific widths and lengths, ranging from about nine inches to twenty-four inches wide and five or ten feet long.⁶² The intended focus was not that of individual boards but rather of wood grain

⁶¹ Gilbert Stanley Underwood, *A Scheme for the Development of the Public Concessions in Grand Teton National Park, Wyoming*, December 1, 1950, Folder 831, Box 90, Cultural Interest Series, Record Group III2E, Grand Teton Lodge Company 1953-61, Office of the Messrs. Rockefeller, Rockefeller Archive Center.

⁶² Exact height measurements were not possible during the site visit due to lack of accessibility.

covering the surface of the building uniformly. As at the Ahwahnee and Sun Valley, he specified that the concrete be colored with acid stains to simulate the color of wood. Three different colors were used, and the stain was brushed on in layers to create a very realistic sense of depth and variation, as would be seen on a real panel of wood. In this way, Underwood imparted a kind of abstract rusticity to the exterior of the Lodge, referencing not only traditional wood construction but his own particular take on rustic architecture. He took the iconic style of log cabin construction with its round, log framing and flattened it, creating a highly stylized version.

The Ahwahnee Hotel, Sun Valley Lodge, and Jackson Lake Lodge are three buildings designed over the course of Underwood's career that are closely tied by a single, signature feature: board-marked finished concrete. Despite their distance from each other by ten and nearly twenty years, these buildings share this common theme. Even as Underwood explored other building styles and materials over his career he returned to this one in particular, reinterpreting and honing it until it reached a zenith at Jackson Lake Lodge.



Figure 21: Postcard for Baltimore Hotel, Los Angeles, circa 1905. Credit: <http://web.csulb.edu/~odinthor/socal1a.html>.

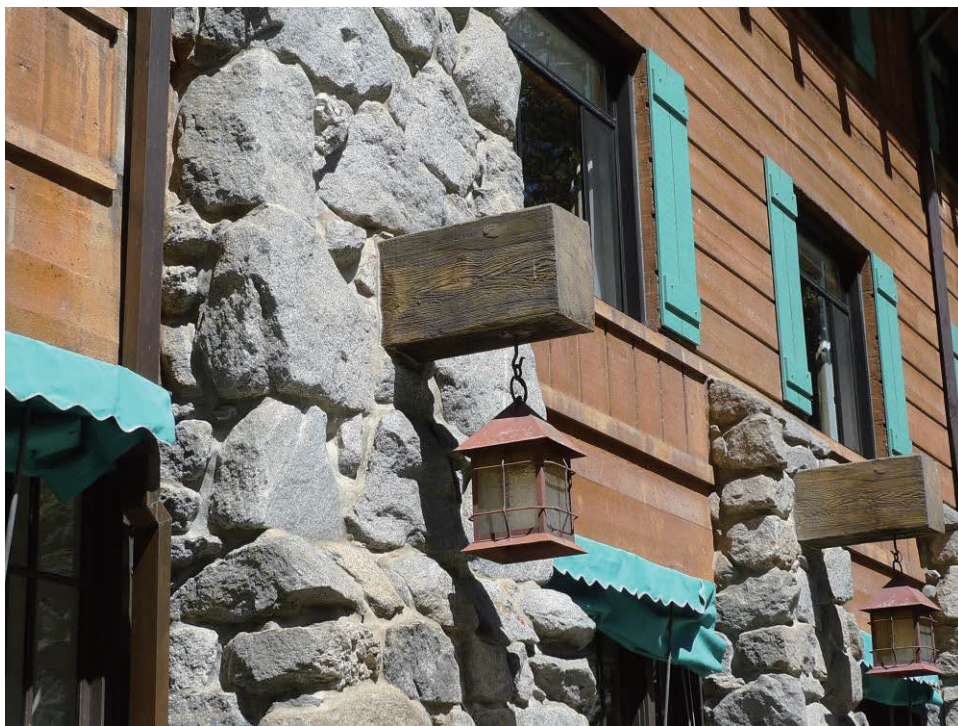


Figure 22: Contemporary image of the Ahwahnee Hotel, detail of molded and stained concrete. Credit: C. Tonetti.



Figure 23: Contemporary image of Sun Valley Lodge, Utah, illustrating formed and stained concrete. Credit: http://cdn.allsunvalley.com/images/content/7229_8057_Sun_Valley_Village_Idaho_md.jpg.



Figure 24: Concrete formwork for Shadowood, circa 1954. Note thin strips of plywood at top of forms. Credit: Herbert Pownall, Jackson Hole Historical Society.

Chapter 2

Molding Modern: Concrete Formwork and Finishes

2.1 Decorative Concrete Finishes

When Gilbert Stanley Underwood specified that rough-sawn boards be used in the concrete formwork at the Ahwahnee Hotel, he was drawing from a number of concrete finish treatments that had become increasingly popular in the U.S. in the 1920s. While using wood for the formwork was standard practice in concrete construction, leaving the impression of the woodgrain as the final exterior appearance was fairly novel. Even when the Romans used wooden formwork to place their concrete (the marks are still visible), it was soon covered with a veneer of brick or marble. The appreciation of concrete as an expressive architectural material came towards the end of the 19th century, after at least one hundred years' worth of experimentation and development.

Concrete is an ancient material – only the binder has changed over time. Roman concrete technology was lost after the fall of the empire, but revived in the mid-eighteenth century when a 'cement was sought that could withstand a wet environment. John Smeaton's discovery of how to produce such natural hydraulic cements in 1756⁶³, followed by Joseph Aspdin's 1824 promotion of artificial Portland cement (so called because of its similarity to the color of a desirable stone from the Isle of Portland), served as the catalysts for experimentation and re-development of concrete technology. As production techniques,

⁶³ Jasper O. Draffin, *A Brief History of Lime, Cement, and Concrete and Reinforced Concrete* (Chicago: Journal of Western Society of Engineers, 1943), 6.

such as the introduction of rotary kilns⁶⁴, improved, the use of concrete⁶⁵ became more widespread. The study and use of hydraulic cements rose in tandem with other structural materials, such as steel, and both allowed for the proliferation of industrial and engineering projects throughout the 19th century.⁶⁶ The Industrial Revolution introduced new ways of working that demanded new types of buildings. Steel and concrete allowed for buildings to become taller and for bridges to span greater distances. Separately, both were praised for their strength and relatively fireproof qualities. However, although concrete could withstand significant compressive forces, it quickly failed in tension. The addition of iron bars to concrete not only provided the necessary tensile strength, but concrete's high alkaline environment protected the iron from oxidizing, as well as from damage from fire. There was a great need for buildings that could resist fire, especially in commercial areas of the dense downtowns of major cities. There was also a need to build relatively quickly and cheaply. The union of concrete and iron or steel reinforcement introduced a new era of standardization and mass production.

Despite its frequent use as a structural material in the 18th and especially the 19th centuries, reinforced concrete was considered too dull and plain to stand on its own and was often covered with a facing material of brick, terra-cotta, or stucco. Exposed, or "fair-faced", concrete was common only in industrial applications, such as factories, silos, bridges, and

⁶⁴ Jasper O. Draffin, *A Brief History of Lime, Cement, and Concrete and Reinforced Concrete* (Chicago: Journal of Western Society of Engineers, 1943), 12.

⁶⁵ Although the terms cement and concrete are used interchangeably here, they are distinct from each other. Cement is an ingredient of concrete and can be used independently, while concrete without cement is just water and aggregate.

⁶⁶ This paper will specifically address the use of concrete in America, although many advances were first made in England and, especially, France.

dams.⁶⁷ As a result, the use of concrete as a decorative material was not fully appreciated until long after its use in structural applications had become commonplace. According to one historian, "[T]he full comprehension of the material's design potential [was] surpassed by arguments of production economy – an important fact indeed, but often put forward as an excuse for poor design in terms of material specificity".⁶⁸ However, concrete's versatility, low cost, and relative ease of use, at least when compared to the labor intensive processes of extracting and shaping stone or producing complicated terra-cotta molds, eventually inspired architects to begin experimenting with concrete's potential as a decorative material. At first, it was used to replicate the traditional ornamentation found in historically derived styles such as the Classical and Gothic revivals and was marketed as a type of cast stone.⁶⁹ Yet many architects rejected the idea that concrete should be used as an imitative material and the issue was debated across many architectural journals and other publications. For example, Cass Gilbert, writing in *Architectural Forum*, stated:

Why attempt to adorn this simplicity [concrete] with trinkets and gewgaws...or fictitious corbels, cornices, capitals, or other details culled from traditional architecture constructed of other materials? In short, the logic forbids such intrusions.⁷⁰

This is in stark contrast to an article written only one year earlier by Walter W. Clifford, in which he describes "four possibilities in the surface treatment or decoration of concrete: it

⁶⁷ Theodore Prudon, "Concrete Atlantis: The "Faces" of Concrete in the U.S." in *The Fair Face of Concrete: Conservation and Repair of Exposed Concrete, Proceedings International DOCOMOMO Seminar* (Eindhoven: Eindhoven University of Technology, 1997).

⁶⁸ Berthold Burkhardt, "A Modern Movement in Engineering: Structural Developments in Architectural History", in *The Fair Face of Concrete: Conservation and Repair of Exposed Concrete, Proceedings International DOCOMOMO Seminar* (Eindhoven: Eindhoven University of Technology, 1997), 27.

⁶⁹ Economy Concrete Co., *Many Examples of the Use of Decorative Concrete Stone, Fifth Edition* (New Haven: Economy Concrete Co., 1917).

⁷⁰ Cass Gilbert, "Industrial Architecture in Concrete" in *Architectural Forum* 39 (September 1923), 84.

may be painted; decoration may be added in the form of brick panels or inserted tile patterns; the desired finish may be obtained with the cement, or the aggregate may be selected to give the desired tone and texture...".⁷¹ The debate about the treatment of exposed concrete continued throughout the 1920s, but once architects recognized the nearly limitless potential of concrete to be shaped and molded, the concrete industry saw an increase in the diversity of finish treatments.

Cement production companies and societies soon took up the cause, publishing numerous pamphlets touting the decorative qualities of concrete. "Concrete – the structural material – has become an architectural medium", proclaimed a publication by the Portland Cement Association, "No longer must it hide beneath the veneers and walls of another material. Honestly and frankly it has been brought to the surface to express, in its own way, the beauty, brilliance, and dignity of architectural design".⁷² Experimentation with color, texture, and pattern expanded greatly during this time, introducing finishes that ranged widely:

...the architect designing in concrete has at his command the various grain marks and joint lines of unfinished or dressed form lumber; the smooth surfaces of plywood or fiber board; the rough textures of exposed aggregates produced by acid washing or tooling; the endless choice of effects obtainable with stucco dash coats or heavier trowelled and hand thrown stucco; and the etched textures made by sand blast and stencil.⁷³

In his designs for the Ahwahnee Hotel, Sun Valley Lodge, and Jackson Lake Lodge, Gilbert Stanley Underwood chose to experiment with a board-marked surface texture and

⁷¹ Walter W. Clifford, "Exterior Concrete" in *Architectural Forum* 36 (February 1922), 68.

⁷² Portland Cement Association, "Beauty in the Walls of Architectural Concrete" (Chicago: Portland Cement Association, 1936), 1.

⁷³ Ibid.

coloration technique that employed acid stains. However, there were, and still are, many other types of finish treatments available.⁷⁴ These finishes can generally be grouped into two categories: integral and applied.

2.1.1 Integral

Any finish that can be considered inseparable from the concrete matrix is an integral finish. These include pigmented cements, special aggregates, and acid stains. In each case, a new component is added to the concrete mixture to change its final appearance. One of the most basic methods for changing the appearance of concrete is to alter the color (Figure 25). The grey color most often associated with concrete comes mainly from the cement used in the mixture and, to a lesser degree, the aggregate.⁷⁵



Figure 25: Example of pigmented concrete. Credit: www.louissmithconstruction.com.

⁷⁴ Only a general overview of concrete finishes are given here, but there are many variations of these treatments that are not discussed in this paper.

⁷⁵ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 15.

Colored concrete is created by adding powdered pigments to the cement mixture. The intensity of the resulting color is based on whether white or grey cement is used, with a white cement base producing more saturated colors. Typical colors produced in combination with a grey cement include red, buff, khaki, and black.⁷⁶ A wider range of colors can be achieved using a white cement as a base because it is more uniform and easily colored. However, this is achieved by a carefully controlled manufacturing process, which can result in a higher cost.⁷⁷ Successful applications of pigmented concrete are limited due to the challenge of producing a uniform color. For this to happen, all bags of colored cement have to come from the same color batch, the same manufacturer (preferably), and be mixed in the same proportions for each section of the building. Even when these precautions are taken, the color can appear blotchy, muddy, or uneven. Therefore, pigmented concrete is usually recommended for use in combination with other types of finishes, such as exposed aggregate.

If there is one decorative concrete finish that can be described as having the most significant impact on the acceptance of concrete as a beautiful material in its own right it is exposed aggregate (Figure 26). This technique was developed by John J. Earley, whose ground-breaking work in concrete transformed the way the material was perceived and utilized from the early twentieth century onwards.⁷⁸ While he did not invent the process of exposing aggregate finishes, he was able to identify the way in which it could be improved. Previous attempts at aggregate exposure resulted in irregular distribution of aggregates

⁷⁶ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 15.

⁷⁷ Ibid, 16.

⁷⁸ A number of theses have been written about Earley and the work of his Studio and provide a more detailed account of his experiments than can be included in this paper. See bibliography for a list.

across the concrete surface. Through experimentation, Earley discovered that uniformity of color was determined by controlling the mixture of cement and aggregate and was unrelated to the process of exposure. By grading aggregates, more of the concrete surface would be filled in by various sizes of rocks in a more even distribution, creating an impression of overall color. Following successful applications of this technique in monumental projects such as Meridian Hill Park in Washington, D.C. and The Fountain of Time sculpture, his patented process became the standard for all exposed aggregate finishes.⁷⁹ Earley was an advocate for the use of concrete as a decorative material long before others in the field recognized its potential, stating that “...concrete has in itself and of its own nature properties, which if skillfully developed and controlled, will make it the most satisfactory architectural and artistic medium ever known”.⁸⁰ Although it would take until the 1930s for American architects to fully embrace concrete in this way, it was John J. Earley whose pioneering work brought it to their attention.

⁷⁹ Lori Renee Aument, *Experimentation in Concrete: John J. Earley at Meridian Hill Park, Washington, D.C.*, Thesis (Philadelphia: University of Pennsylvania, 1999).

⁸⁰ John J. Earley, “Building the Fountain of Time”, *Proceedings of the Journal of the American Concrete Institute* 19, No. 1 (January 1923), 190.



Figure 26: Example of exposed aggregate concrete surface. Credit: www.concrete-evolutions.com.

There are several processes by which aggregate can be exposed in concrete, depending on the desired finish effect. The first is to mechanically remove the top layer of the concrete by brushing, and then washing the surface with acid (traditionally muriatic acid) to enhance the color of the aggregates, which can consist of quartz, marble, or granite. This should be performed when the concrete is still “green”, or when it is just past the point at which it has set and the formwork can be removed.⁸¹ However, there is a limited time frame within which this process can take place, as the concrete will eventually become too hard for any effect to be achieved.⁸² To increase the amount of time in which the concrete can be worked, a retarder is usually added to the mixture.

⁸¹ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 72.

⁸² Ibid.

The surface of the slightly hardened concrete can also be ground and polished to expose the aggregate. However, for this method the aggregate must be made up of the type of rocks that will take a polish.⁸³ Sand-blasting is another method by which aggregate can be exposed, but it can be difficult to control the amount of surface material removed in the process.⁸⁴ Finally, in a combination of integral and applied technique, aggregates can be transferred to the surface of the concrete using pre-prepared panels. In this method, the aggregate is glued to panels that are attached to the formwork before the concrete is placed. Once the concrete has set and the formwork is removed, the panels are also removed and the aggregate is exposed by brushing the panel-side of the adhesive.⁸⁵

Other materials besides gravel can be used for this surface treatment. Glass, glazed ceramics, plastic, and shells can also be used.⁸⁶ Exposed aggregate concrete finishes typically weather better than other surface finishes because the aggregate is intended to be revealed over time. This is in contrast to a smooth-finished surface, which loses its effect as the aggregate is exposed through weathering over time. By carefully selecting colorful and durable aggregates and concentrating them near the surface of the concrete, the action of weathering will continue to produce the desired finish. However, any imperfections or impressions left by the formwork will still be visible and could be accentuated by the process of revealing the aggregate.⁸⁷

⁸³ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 80.

⁸⁴ Ibid, 93-94.

⁸⁵ Ibid, 84.

⁸⁶ Concrete Products, *Architectural Finishes: A Roundup of Ideas and Techniques* (Concrete Products, 1963), 4-5.

⁸⁷ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 71.

A third technique for coloring concrete is to use stains (Figures 27, 28). Although today acid stains are most frequently associated with the decoration of concrete floors, they have been used to color concrete since at least the early 20th century.⁸⁸ Acid staining produces color as the result of a chemical reaction between the calcium hydroxide in the concrete and metallic salts such as iron chloride (reds and yellows), manganese (browns), or copper sulfate (blues and greens), among others.⁸⁹ These salts are applied as a solution of water and hydrochloric acid,⁹⁰ creating an integral, mottled appearance that varies in intensity based on the amount of calcium hydroxide near the surface of the concrete. They are only available in a limited range of earth tones. Following application of the stain, the surface of the concrete is sealed with a wax or other coating for protection and can be polished or left matte. Acid stains do not fade, chip, peel, nor can they be removed or lightened. Subsequent applications will darken the existing shade. Intricate and complicated designs can be created by skilled artists who can manipulate the variegated colors produced by acid staining to mimic the veining of marble.

Non-acidic, water-based stains are also available. These are made up of metallic oxide pigments suspended in water and usually contain a polymer as well.⁹¹ Water-based stains penetrate the surface of the concrete without the use of the acid.⁹² Other types of water-

⁸⁸ Francis S. Onderdonk, *The Ferro-Concrete Style: Reinforced Concrete in Modern Architecture* (New York: The Architectural Book Co., 1928), 105.

⁸⁹ Joe Nasvik, "Decorative Concrete: Using Acid Stains", *Concrete Construction*, December 2009, <http://www.concreteconstruction.net/concrete/using-acid-stains.aspx>.

⁹⁰ Ibid.

⁹¹ Joe Nasvik, "How Acid Stains are Made and Applied", Interview by Julianne Wiesner-Chianese, May 5, 2015.

⁹² Joe Nasvik, "Decorative Concrete: Using Acid Stains", *Concrete Construction*, December 2009, <http://www.concreteconstruction.net/concrete/using-acid-stains.aspx>.

based stains are made up of synthetic pigments and acrylic polymers, instead of metallic salts.



Figure 27: Pool deck stained with Kemiko Cola. Credit: http://www.concretenetwork.com/photo-gallery/stained-concrete_325/78154-tx-custom-concrete-solutions_12398/#next.



Figure 28: Example of decorative acid stained concrete floor. Credit: www.luxuryconcretefloors.com.

2.1.2 Applied

There are four general types of applied concrete finishes⁹³: tooled; solutions or pastes, such as paints and stuccos; molded; and board-marked. Each creates a very different surface appearance, some of which hide the true nature of the material and some of which celebrate it. Unlike integral finishes, applied finishes take advantage of the sculptural potential of concrete to be molded into unusual shapes and to take on the appearance of the surface against which it is formed. Applied finishes create texture and pattern on the surface of the concrete.

Tooled Finishes

Tooling is the process of shaping a material in a decorative way. Traditionally used to carve stones, the term tooling typically refers to the use of a group of hand tools that create different surface textures, although some of these have been mechanized (Figures 29 -31). For concrete, these usually include bush hammers, point tools, and chisels.⁹⁴ The process of tooling requires the removal of some surface material to create texture, pattern, or reveal color from the aggregate and the type of tool used is chosen for the way the marks of the instrument look. For example, point tooling can result in an overall pattern of small indentations, while comb chiseling creates a pattern of regular lines and grooves. Bush hammering is more commonly used for revealing aggregates, rather than for the surface pattern it creates, but many examples can be found of a bush-hammered surface.⁹⁵ There

⁹³ Others not discussed in detail here include enamels, glazing, scraffito, intarsia, mosaics, rubbing/polishing, dimpling, stamping, brooming, scraping, grinding, etc.

⁹⁴ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 74.

⁹⁵ Ibid, 77.

are other instruments that can also be used for tooling concrete, but most are variations of the three types discussed here.



Figure 29: Bush hammer used for tooling concrete and stone surfaces. Credit: <http://www.builderbill-diy-help.com/image-files/masons-bush-hammer.jpg>.



Figure 30: Example of a point-tooled concrete surface. Credit: <http://www.nps.gov/tps/images/briefs/42-tooling.jpg>.

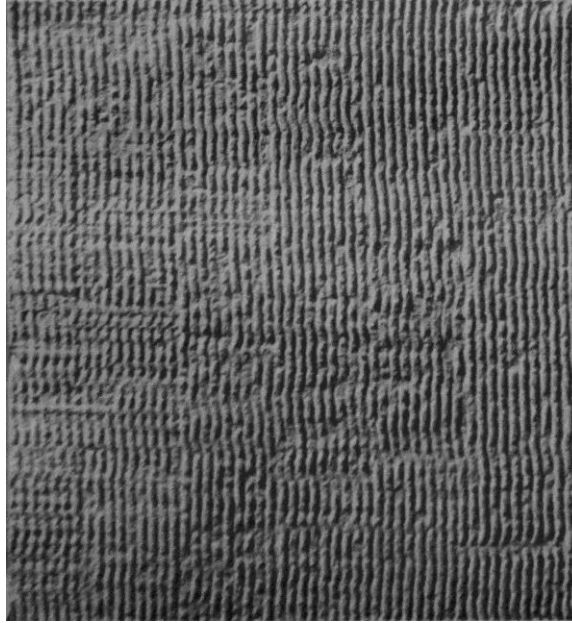


Figure 31: Example of a comb-chiseled concrete surface. Credit: J. Gilchrist Wilson, *Exposed Concrete Finishes*, p. 79.

Tooling can be applied to molded surfaces as well as flat, on the entire surface of the concrete, or only to highlight certain areas. With each type of tooling, more or less material will be removed depending on whether the concrete has only just set or whether it has had the chance to harden over a longer period of time. Care must be taken to select aggregate that can withstand the method of tooling without shattering or fracturing, as this can affect the bond between the aggregate and the concrete matrix, leaving the exposed surface susceptible to loss of aggregates and accelerated effects of weathering.⁹⁶ Therefore, careful selection of aggregates and proper proportioning will result in a surface better suited to tooling, as well as more durable concrete. The biggest challenge to choosing a tooled finish for concrete structures is typically the cost involved in employing skilled workers who are trained in this style of treatment.

⁹⁶ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 74.

Painting and Rendering

Besides enhancing the appearance of the concrete, paints and renders were used to provide some degree of waterproofing, depending on the ingredients of the coating.⁹⁷ They could also hide certain imperfections and undesirable features of the construction process, such as staining from improperly sealed formwork.⁹⁸ Finally, some surface texture could be achieved with the use of sand or cement paints and certain types of rendered finishes.

Paints

One of most common types of paint used for concrete was cement paint, which usually contained a measure of fine sand to help fill in holes and even out the concrete surface while creating a coarse texture.⁹⁹ Two coats were recommended, as the first layer would provide a stronger bond for the second layer than the surface of the concrete. These could be applied by brushing or spraying.¹⁰⁰ Cement paints usually incorporated some waterproofing additive such as a soluble silicate or lime, which was moisture permeable.¹⁰¹ This permeability was important because it allowed efflorescence to form on the surface of the cement paint, instead of on the interior of the concrete where it could be damaging.¹⁰² The risk of efflorescence was one of the drawbacks of painting concrete, but any blooms eventually faded as the fresh concrete had time to weather. For this reason, it was recommended that painting be delayed as long as possible, to allow for the surface to

⁹⁷ Yael Loewenberg, *Historic Concrete Finishes: 1900-World War II*, Thesis, Columbia University, 1987, 57.

⁹⁸ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 101, 110.

⁹⁹ H.L. Childe, *Concrete Finishes and Decoration* (London: Concrete Publications Limited, 1964), 50.

¹⁰⁰ Ibid.

¹⁰¹ Yael Loewenberg, *Historic Concrete Finishes: 1900-World War II*, Thesis, Columbia University, 1987, 57.

¹⁰² Ibid, 57.

become free of impurities such as dust and residual oils from the forming process.¹⁰³ While it was essential for the concrete surface to be carefully cleaned prior to painting, especially smooth surfaces of concrete made the use of cement paints challenging because of the lack of a “key”, or surface texture to which the cement could adhere.¹⁰⁴ In these cases, the surface of the concrete could be washed with a mild solution of hydrochloric acid, lightly sand-blasted, or rubbed with coarse stones to create a rough texture.¹⁰⁵

Preparation of the concrete surface is critical to the success of paints. As already stated, the surface should be free of dust, dirt, and oil residue. Surface preparation was especially important for the use of organic paints, because they often consisted of an oil base, such as linseed. Because a reaction between the alkali metals present in the concrete and the vegetable-base oil in the paint would cause the paint to saponify, the concrete surface had to be neutralized with a mild solution of magnesium fluosilicate or zinc sulfate dissolved in water.¹⁰⁶ This remained standard practice until the availability of synthetic resin paints after World War II, after which use of oil-based paints declined.¹⁰⁷

Protection of the painted surface was usually provided by a sealant or coating of varnish, resin, or even starch.¹⁰⁸

¹⁰³ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 111.

¹⁰⁴ Ibid.

¹⁰⁵ Ibid.

¹⁰⁶ Ibid, 112.

¹⁰⁷ Yael Loewenberg, *Historic Concrete Finishes: 1900-World War II*, Thesis, Columbia University, 1987, 60.

¹⁰⁸ Portland Cement Association, “Concrete in Architecture” (Chicago: Portland Cement Association, 1927), 55.

Renders

Also known as stucco, renders have a very long history of use on buildings. They are most often used to create a uniform surface, but can also be treated decoratively by being given a textured finish. As with cement paints, the preparation of the surface of the concrete determines whether or not the render will adhere properly. This is because a key must be provided on the surface so that the render will have something to which it can bond. A suitable surface for renders can be achieved by brushing and washing the concrete or bush hammering, the same procedures used to create exposed aggregate finishes.¹⁰⁹ Other methods for creating a suitable surface include using rough materials in the formwork to leave a textured imprint and throwing a wet mixture of cement and sand at the concrete surface.¹¹⁰ Once the surface of the concrete is clean of impurities and has a rough texture, two or three coats of stucco or render are applied (Figure 32). These are usually a mixture of cement, sand, and lime putty.¹¹¹ The final coat serves as the finished layer and can be smooth or textured. A wide variety of textured finishes is available including scraped, hammered, stippled, and dashed. Stucco and rendered finishes were used very frequently as exterior and interior concrete coatings. The main cause of failure was the lack of proper adhesion to the substrate.

¹⁰⁹ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 102.

¹¹⁰ Ibid.

¹¹¹ Yael Loewenberg, *Historic Concrete Finishes: 1900-World War II*, Thesis, Columbia University, 1987, 29-30.

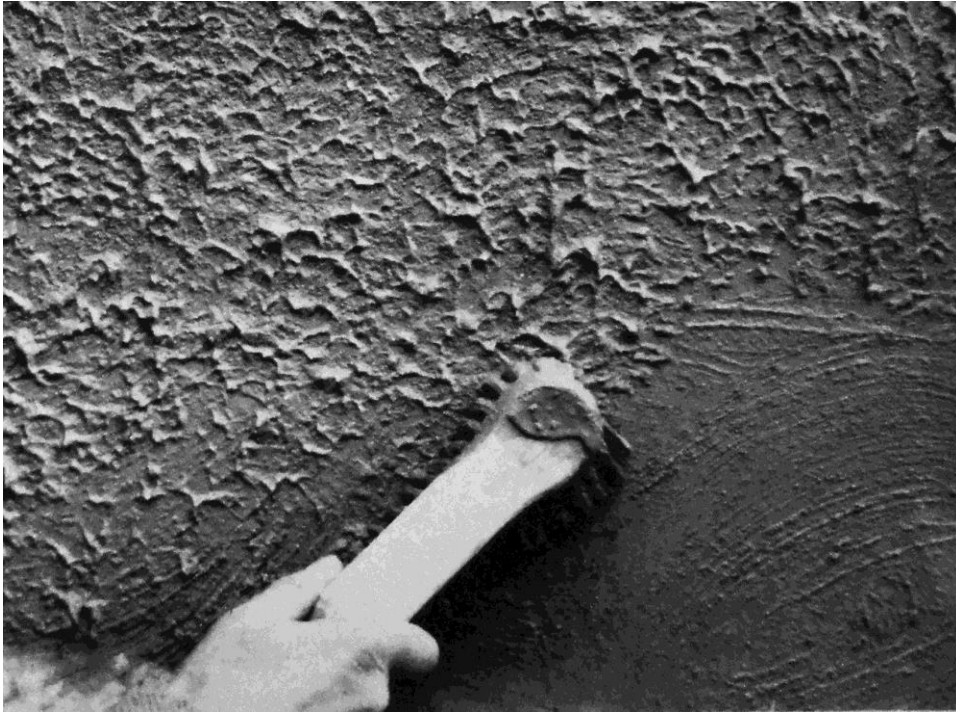


Figure 32: Preparation of concrete surface for finish coat of render. Credit: J. Gilchrist Wilson, Exposed Concrete Finishes, p. 103.

Molded Finishes

So far, the discussion of concrete surface finishes has addressed mainly one-dimensional treatments that affect only the first inch or so of the concrete. Molded finishes, on the other hand, are three-dimensional, exploiting the ability of concrete to assume many different shapes. This type of surface treatment utilizes a variety of materials in the formwork to create rhythmic patterns and textures in cast-in-place and pre-cast concrete. The results can be quite elaborate, ranging from delicate Gothic tracery, to figural sculpture carved like stone, to complicated repetitive patterns.

Like stuccos and renders, casting and molding have a long history in the ornamentation of buildings. Cast and molded concrete was often used as an imitation stone, either as a

replacement for lost or broken elements of a masonry structure or in its own right as a building material.¹¹² These elements were made either through the cast-in-place or pre-cast processes using plaster or glue molds.¹¹³ Both types of molds were used for casting ornamental details in concrete, but “glue molds [were] used when the design [had] heavy, undercut relief as they can be made in fewer pieces and can be more easily removed which decreases the danger of injuring the delicate parts of the green concrete”.¹¹⁴ Because concrete could assume such a wide variety of shapes and fine details without the extractive labor required for carved stone or the cost of terra cotta, it soon replaced both materials in the building industry.¹¹⁵

A subset of molded finishes are those that are created by casting concrete against a variety of materials placed within the formwork such as canvas, rubber and/or plastic sheets, corrugated iron, etc. (Figure 33).¹¹⁶ The formwork itself can also be shaped to create fluted, reeded, or other details that have a carved appearance.¹¹⁷ However, one of the most common formwork finishes are board-marked, so-called because of the impression of the grain from the wooden formwork boards on the surface of the concrete. Although all concrete that is cast in wooden forms will take on the impression of the grain, “those produced direct from carefully designed formwork are possibly the most rewarding...”¹¹⁸

¹¹² H.L. Childe, *Concrete Finishes and Decoration*, (London: Concrete Publications Ltd., 1964), 121-124.

¹¹³ Francis S. Onderdonk, *The Ferro-Concrete Style: Reinforced Concrete in Modern Architecture* (New York: Architectural Book Co., 1928), 119.

¹¹⁴ Ibid, 120.

¹¹⁵ Yael Loewenberg, *Historic Concrete Finishes: 1900-World War II*, Thesis, Columbia University, 1987, 17.

¹¹⁶ H.L. Childe, *Concrete Finishes and Decoration*, (London: Concrete Publications Ltd., 1964), Chapter 2.

¹¹⁷ Ibid, Chapter 2.

¹¹⁸ J. Gilchrist Wilson, *Exposed Concrete Finishes: Finishes to In-Situ Concrete*, Volume 1 (New York: John Wiley & Sons, Inc., 1964, 55.

Because the production of board-marked finishes is inseparable from the design of the formwork, it will be discussed in more detail in the following section.

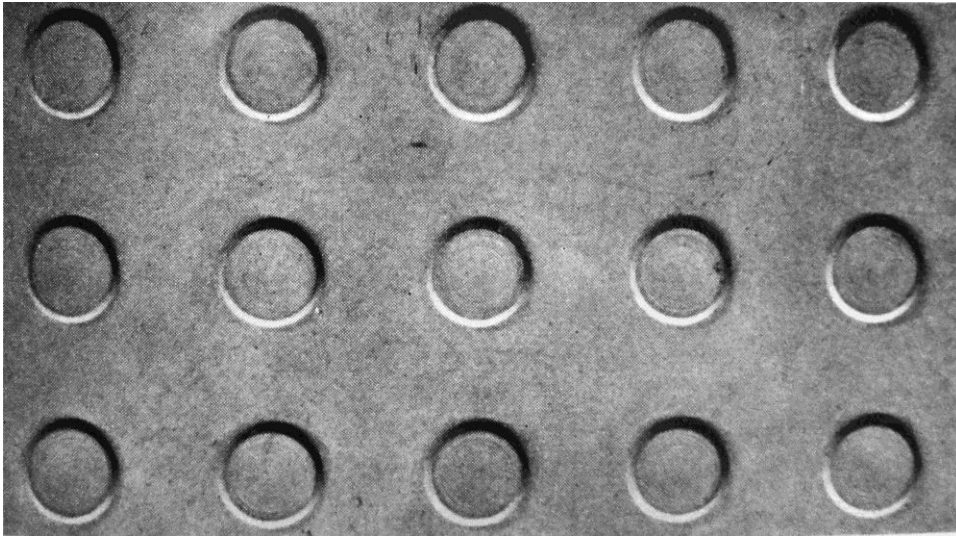


Figure 33: Example of molded concrete using rubber as a form liner. Credit: H.L. Childe, Concrete Finishes and Decoration, p. 37.

Although the widespread use of concrete as a decorative material in the U.S. took some time to achieve prominence, staunch advocates in the 1920s continued to promote its sculptural qualities:

Hundreds of concrete buildings all over the world...testify that proper workmanship produces durable, pleasing concrete surfaces. Brick, stone, and marble backed by traditions of thousands of years are not so exposed to slovenly treatment as their modern Cinderella-sister, concrete.¹¹⁹

¹¹⁹ Francis S. Onderdonk, *The Ferro-Concrete Style: Reinforced Concrete in Modern Architecture* (New York: Architectural Book Co., 1928), 53.

By the 1930s, architectural styles such as Art Deco and the International style would take full advantage of concrete's diverse and varied applications. Following his chapter on the multiple types of finish treatments for concrete in his book *The Ferro-Concrete Style: Reinforced Concrete in Modern Architecture*, Francis Onderdonk writes, "It has been shown that a wide range of techniques can be employed to decorate concrete surfaces. Hence the often encountered opinion that concrete surfaces lack architectural qualities is not justified. On the contrary [it] presents so many possibilities, that it is hard to choose among them".¹²⁰ Architects designing in concrete from the 1930s onward would take full advantage of the myriad decorative techniques available, but it was board-marked finishes that would ultimately take center stage.

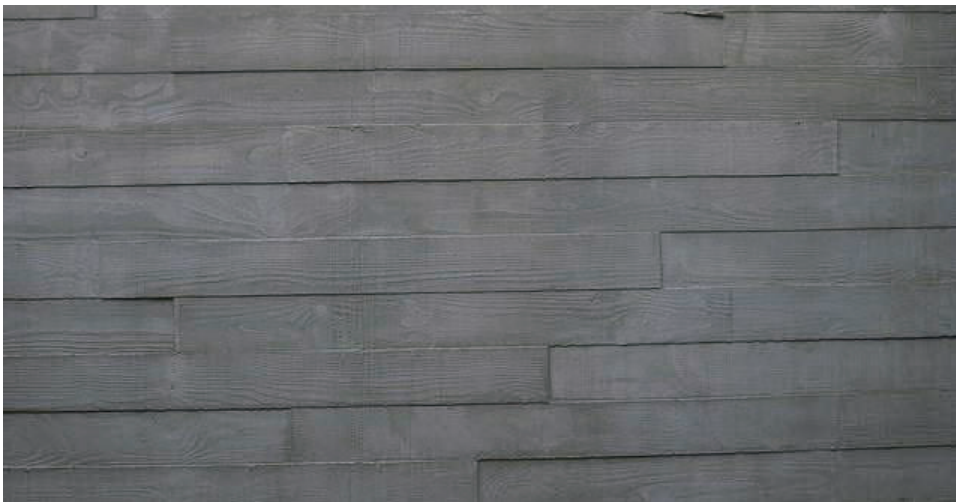


Figure 34: Example of board-marked concrete finish. Credit: www.concretenetwork.com.

¹²⁰ Francis S. Onderdonk, *The Ferro-Concrete Style: Reinforced Concrete in Modern Architecture* (New York: Architectural Book Co., 1928), 130.

2.2 Formwork

Gilbert Stanley Underwood used board-marked finishes throughout his career. Beginning with the Ahwahnee Hotel in 1927, Underwood was among the first to use this type of surface treatment for concrete, which originated in the U.S. and Switzerland throughout the 1920s and 30s.¹²¹ While his design for the concrete at the Ahwahnee employed a fairly basic method of horizontally-laid boards, the board-marked finish for Sun Valley ten years later was much more complex, with boards laid diagonally. By this time, however, board-marked finishes were much more common, proliferating in reaction to a long period of smooth, grain-less finishes. As described in the 1936 pamphlet *Forms for Architectural Concrete*, “Every effort was made in the earlier buildings to produce smooth surfaces...Following [this] period...there was an inclination on the part of some designers to swing in the other direction until the opposite extreme was reached...”¹²² Experimentation with both smooth and rough textured concrete surfaces resulted in the same conclusion, namely that formwork was paramount. In the *Proceedings of the American Concrete Institute* of 1927, F.L. Ackerman summarized the importance of formwork to the future of concrete architecture: “Our theory of concrete design resolves itself immediately into a theory of building the preparatory structure, the form...the form is the beginning and the end of concrete design”.¹²³ The quality of the formwork directly affects the quality of the concrete. This is significant not only because of how the visual quality is affected but also because formwork is one of the most costly items in construction.¹²⁴ High-quality formwork requires the

¹²¹ H.L. Childe, *Concrete Finishes and Decoration* (London: Concrete Publications Ltd., 1964), 19.

¹²² Portland Cement Association, *Formwork for Architectural Concrete* (Chicago: Portland Cement Association, 1936), 1.

¹²³ F.L. Ackerman, *Proceedings of the American Concrete Institute*, 1927, 259.

¹²⁴ Portland Cement Association, *Basic Concrete Construction Practices* (New York: John Wiley & Sons, Inc., 1975), 3.

selection of good materials and it must be carefully designed, planned, and built by a skilled team.¹²⁵ Gilbert Stanley Underwood understood the importance of formwork in his design for Jackson Lake Lodge and the Shadowood and this is clear from the uniformity of the exterior, the minimal appearance of cracks (besides temperature cracks that form as a natural part of the curing process), and the lack of blemishes or post-construction patching. To achieve this, Underwood would have had strict control over the way the formwork was assembled and how the concrete was poured.

For cast-in-place concrete structures that are intended to have exposed concrete surfaces, the design of the formwork is often described by the architect in the construction drawings or explained in detail in the specifications. This process differs from the design of formwork for structural concrete, as the finished appearance is less important. In his book *Formwork for Concrete Structures*, R.L. Peurifoy describes the distinction between structural and architectural concrete: “Architectural concrete differs from structural concrete in that the appearance of the exposed surfaces of the former may be of greater importance than the strength of the members”.¹²⁶ While all formwork must be designed in a safe and effective way, formwork for architectural concrete places a greater emphasis on the selection of wood, nails, and form liners.

Formwork can be built on site or prefabricated as panels that are assembled at the worksite.¹²⁷ The design and components of the formwork vary depending on which building element is being cast, but the general idea remains the same: a frame or container in which

¹²⁵ For the purposes of this paper, only the design of formwork for walls will be discussed. Other components, such as floors and roofs, will not be covered. There are also other materials besides wood that can be used to build forms, but these are not within the scope of this paper and will not be discussed here.

¹²⁶ R.L. Peurifoy, *Formwork for Concrete Structures* (New York: McGraw Hill Book Co., 1964), 285.

¹²⁷ *Ibid*, 142.

the fluid concrete can be placed while it hardens. Formwork needs to be able to withstand significant pressures, and support both live and dead loads.¹²⁸ The weight of the concrete, the weight of the formwork itself, and the weight of workmen and equipment all must be accounted for in the design. To help with these calculations, tables are included in many of the construction manuals. Guidance is also provided for the selection of appropriate materials, such as lumber and hardware, while illustrations are used to explain detailed connections.

For architectural concrete the selection of proper formwork lumber is all-important. Although the type of wood used will vary depending on the desired finish, softwoods are often used due to their abundance and lighter weight, which makes them more affordable than hardwoods.¹²⁹ In particular, Douglas fir and Southern yellow pine are popular because of their ease of use and strength, with Douglas fir being lighter and a little softer.¹³⁰ When the impression of the grain is intended to be left on the concrete surface, lumber for formwork can be “dressed” or milled with a variety of textures depending on the way it is cut. For example, circular-sawn timbers will leave a different impression than band-sawn timbers.¹³¹ The grain can also be raised chemically or mechanically by treating the lumber with acid, or by wire brushing or sand-blasting the surface for a more pronounced texture.¹³² For smooth finishes, formwork boards should have the opposite surface texture, relatively free of knots and grain marks. Narrow tongue-in-groove floor boards are well-suited to creating smooth finishes, due to their tightly interlocking nature, which prevents

¹²⁸ Portland Cement Association, *Basic Concrete Construction Practices* (New York: John Wiley & Sons, Inc., 1975), 13.

¹²⁹ *Ibid.*, 32.

¹³⁰ *Ibid.*, 20.

¹³¹ J. Gilchrist Wilson, *Exposed Concrete Finishes* (New York: John Wiley & Sons, Inc., 1964), 57.

¹³² Concrete Products, Ed., “Architectural Finishes: A Roundup of Ideas and Techniques” in *Concrete Products* (January – March, 1963), 13.

leakage and reduces warping.¹³³ If a truly smooth finish is desired, plywood, along with form liners made of materials other than wood, can be used. Form liners refer to “material in large sheets which may be nailed directly to the studs or applied over ordinary sheathing lumber”¹³⁴, the most common of which is plywood.

Plywood is built up of an odd number of layers of thin sheets of Douglas fir that are glued together. The grain of each sheet is placed at right angles to those of the adjoining sheets to increase strength and stability. Plywood can be produced in boards ¼” thick, though thinner sheets are also possible.¹³⁵ Because plywood is available in such thin sheets, it is often used as a form liner, instead of as the primary formwork lumber. However, this changed after 1950 and plywood became the standard wooden formwork material.¹³⁶ When used to create a smooth surface finish, it is recommended that only exterior grade plywood be used because it is coated with a water-resistant oil, lacquer, or plastic that resists the transfer of the wood grain. Having a fairly impervious surface also allows the plywood formwork to be used multiple times, a highly desirable cost-saving feature.¹³⁷

The formwork must be rigid, as there is a lot of movement that takes place in, on, and around it over the course of construction. When the concrete is placed in the formwork it is heavy, consisting of the cement paste, aggregates, and water. It is then vibrated to achieve greater consolidation. Formwork must be designed to withstand the movement of the

¹³³ J. Gilchrist Wilson, *Exposed Concrete Finishes* (New York: John Wiley & Sons, Inc., 1964), 56.

¹³⁴ Portland Cement Association, *Forms for Architectural Concrete* (Chicago: Portland Cement Association, 1936), 36.

¹³⁵ R.L. Peurifoy, *Formwork for Concrete Structures* (New York: McGraw Hill Book Co., 1964), 287.

¹³⁶ Donald Friedman, *The Investigation of Buildings* (New York: W.W. Norton & Co., 2000), 73.

¹³⁷ Concrete Products, Ed., “Architectural Finishes: A Roundup of Ideas and Techniques” in *Concrete Products* (January – March, 1963), 13.

concrete without buckling or collapsing due to increased pressure.¹³⁸ The combination of the components of site-built, wooden formwork for walls¹³⁹ is designed to provide the necessary rigidity (Figure 35).

Sheathing is the part of the form that faces the concrete and is made up of wooden boards.

Studs are single vertical or horizontal wood members to which the sheathing is nailed. They can be made up of boards sized 2x4, 2x6, or larger.

Wales are installed on the opposite side of the form, perpendicular to the studs to hold them in position, assure good alignment, and receive the form ties. They are double horizontal wooden members sized 2x4, 2x6, or larger.

Bracing acts like a prop or a buttress and is usually angled toward the forms from the ground or from another member.

Strongbacks can be added for rigidity and are installed perpendicular to wales.

Top, bottom, and sole plates are pieces of wood nailed to the form to enclose a section of framing.

Form ties are wires or rods that span the width of the form to help the forms resist bursting pressures from the fluid concrete. They can be left within the concrete or removed after casting and come in a variety of configurations. For architectural concrete, where the finished surface must be free of as many blemishes as possible, form ties that are removed

¹³⁸ Portland Cement Association, *Basic Concrete Construction Practices* (New York: John Wiley & Sons, Inc., 1975), 16.

¹³⁹ R.L. Peurifoy, *Formwork for Concrete Structures* (New York: McGraw Hill Book Co., 1964), 143-144.

should not leave holes larger than 7/8" in diameter. The exposed tie should be placed at least 1 1/2" from the surface and the area filled in to prevent water infiltration.¹⁴⁰

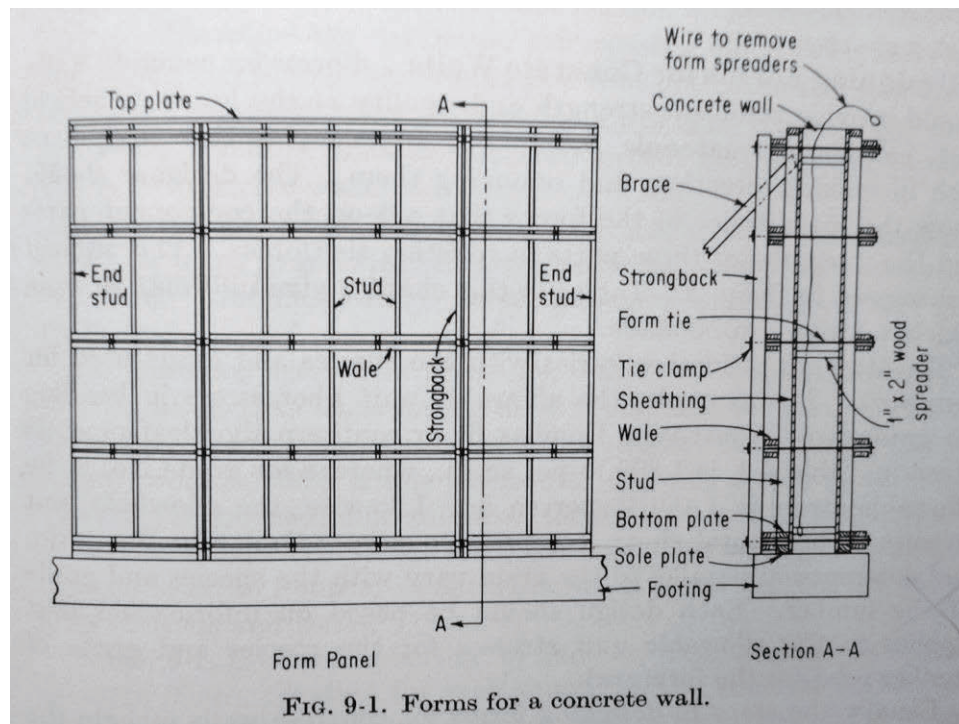


Figure 35: Illustration of formwork components. Credit: R.L. Peurifoy, *Formwork for Concrete Structures*, p. 144.

All of these components are connected using nails of various sizes. Formwork that is site-built for architectural concrete often uses box nails to attach sheathing to the studs or to attach thin sheets of plywood form liners. This is due to the fact that box nails have a thinner shank than common nails, resulting in less damage to the lumber upon removal.¹⁴¹

The importance of quality formwork for architectural concrete has already been stated. However, even with careful designing, the selection of high grade lumber, and excellent assembly of all components, blemishes and imperfections on the surface of the concrete are

¹⁴⁰ R.L. Peurifoy, *Formwork for Concrete Structures* (New York: McGraw Hill Book Co., 1964), 289.

¹⁴¹ Ibid, 289.

still possible. Many of these are the result of using poor quality, old, or over-used boards, where warping, bending, and uneven absorption are common. If the seal between the individual boards is not completely watertight, leakage of the concrete paste or water results in projecting “fins” or dark lines on the finished surface.¹⁴² Other blemishes occur as a result of the placing process. Small holes from the presence of air bubbles may be left on the surface after curing. These are formed during tamping or compaction.¹⁴³ Precautionary steps can be taken to minimize the occurrence of these imperfections, but architects will often specify how to repair or “make good” blemishes once the concrete has set.

When Gilbert Stanley Underwood designed his Shadowood for Jackson Lake Lodge, he planned carefully for a very specific surface finish that relied on quality formwork and materials. The formwork frame was constructed using the components previously described: studs and wales made up the vertical and horizontal members and were held together by top, bottom, and sole plates. Strongbacks and bracing provided additional support. The plywood was used as both re-useable sheathing and form liner. In-between the formwork, wooden spacers were placed to maintain the correct width of the form as the concrete was added (Figure 36). These were removed once the concrete reached the necessary height.¹⁴⁴ In addition to spacers, form ties kept the frame as rigid as possible.

¹⁴² H.L. Childe, *Concrete Finishes and Decoration* (London: Concrete Publications Ltd., 1964), 1-2.

¹⁴³ Ibid, 2.

¹⁴⁴ International Textbook Company, *Concrete Construction* (Scranton: International Textbook Co., 1956), 39.

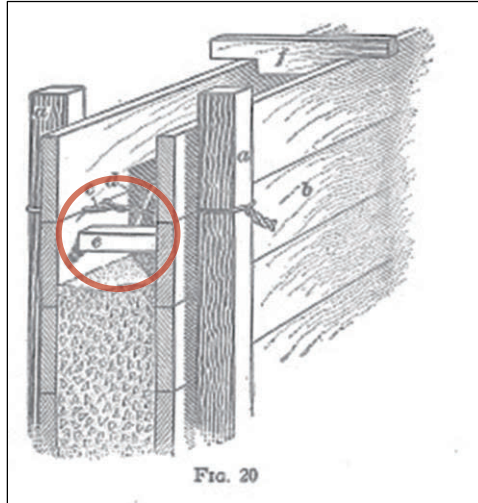


Figure 36: Example of formwork with spacer (circled). Credit: *Concrete Construction*, International Textbook Company, p. 39

Many types of form ties were available including wire, bolts, rods, and screws. Wire was the most commonly used due to its low cost. It was passed through the forms and twisted until tight. However, wire presented many problems, especially in architectural concrete applications, because of its tendency to stretch, deform, cut into the wood, and leave large holes to facilitate cutting the ends after use, if they could not be pulled out of the concrete without causing damage. For these reasons, wire ties “should not be used under any circumstances on an architectural concrete job”.¹⁴⁵ Bolts provided a better solution, but were a bit large, whereas unthreaded pencil rods were both rigid and slender (Figure 37). Besides being a good size, pencil rods were also inexpensive. These were run through studs, wales and sheathing, and secured on both sides of the form with clamps held closed with screws.¹⁴⁶ An even more economical form tie was the “tyscru”, which acted as both form tie and spacer: “the device consists of a continuous wire spiraled at each end to provide a

¹⁴⁵ Portland Cement Association, *Forms for Architectural Concrete* (Chicago: Portland Cement Association, 1936), 21.

¹⁴⁶ *Ibid*, 22.

socket into which a form screw can be entered during construction..." (Figure 38).¹⁴⁷ As with wire ties and pencil rods, the key factor for architectural concrete was for the form tie holes to remain as inconspicuous as possible after construction.

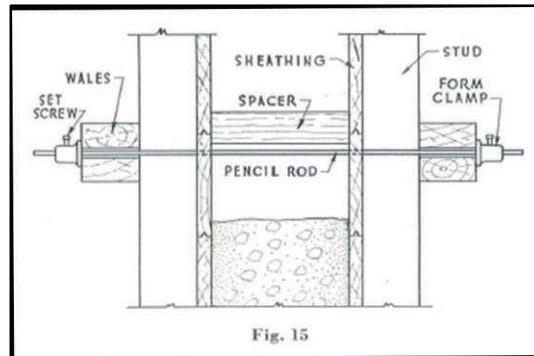


Figure 37: Illustration of the use of a pencil rod in formwork. Credit: *Forms for Architectural Concrete*.

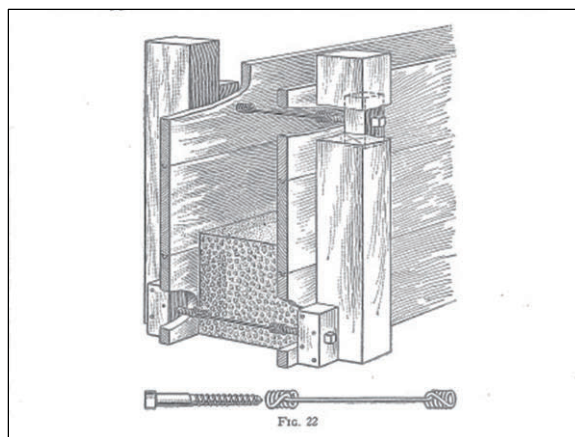


Figure 38: Example of a "tyscru" used in formwork. Credit: *Concrete Construction*, International Book Company, p. 41.

Another feature of cast-in-place concrete that should stay invisible is the line demarcating one pour of concrete from the next. These construction, or "cold", joints occur when the first layer of concrete has begun to harden before the next layer of more fluid concrete is placed. The difference in consistency means different drying rates, made visible by a line on the

¹⁴⁷ International Textbook Company, *Concrete Construction* (Scranton: International Textbook Co., 1956), 41.

surface of the concrete. This is very undesirable in architectural concrete but can be avoided with careful planning (Figure 39). While the sills and heads of openings, such as windows, provide a natural breaking point, at Jackson Lake Lodge Underwood added another feature to keep each “lift” of concrete as short as possible. By using rustication joints, Underwood was able to hide the connection between each lift (Figure 40). These were formed by tacking a chamfered strip of wood to the sheathing that projects out from the form.¹⁴⁸ Once the form is removed, a recessed joint remains where the projecting strip had been. With many of the windows being quite tall, rustication joints were added at intervals along the height of each opening. Because of the strong horizontal lines created by these joints, Underwood used it to his advantage, including vertical rustication joints in his design that created a distinctive grid pattern on the surface of the concrete. These rustication joints also served to control and contain cracking during expansion and contraction of the concrete.

¹⁴⁸ H.L. Childe, *Concrete Finishes and Decoration* (London: Concrete Publications Ltd., 1964), 6.

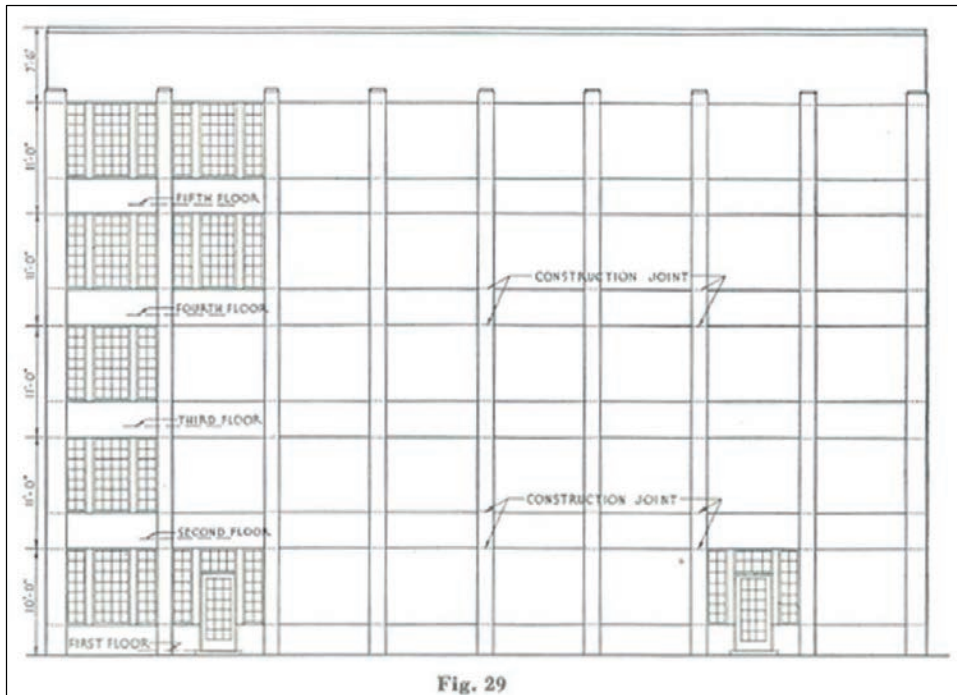


Figure 39: Illustration of recommended placement of construction joints. Credit: *Forms for Architectural Concrete*.

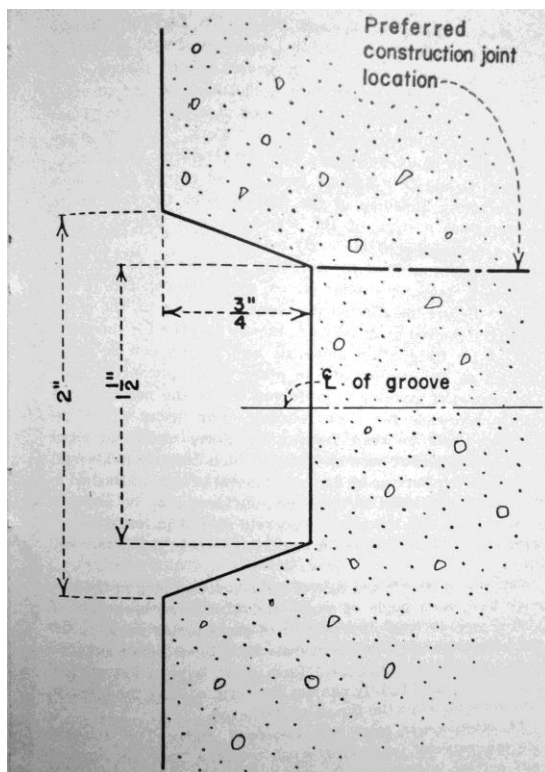


Figure 40: Illustration of pour line in rustication joint. Credit: *Concrete Manual*, p. 245

In addition to the grid pattern, the other, perhaps most, distinctive feature of Jackson Lake Lodge is the woodgrain texture on the surface of the concrete that Underwood called Shadowood. Although Shadowood was already a proprietary name for a type of redwood plywood that was being manufactured in the 1950s (Figure 41)¹⁴⁹, Underwood used the term without reference to any source. He also did not specify using any particular redwood Shadowood plywood for the form lining. Though the origin of Underwood's use of the term remains a mystery, his intentions for using redwood plywood as the form liner is clear. In order to create a uniform surface texture that imitated redwood, sheets of plywood of varying widths were placed vertically in the form work and nailed to the studs. Plywood sheets could be made in many sizes, the largest standard width being 48" but other widths were possible for an additional cost. Lengths were typically eight feet, but twelve was also available, again at a higher price.¹⁵⁰ The plywood sheets were nailed to the formwork studs at the junction of each sheet. Though the exact type of nail used is unknown, three-penny blue shingle nails were recommended in construction manuals due to their strength and ease of removal without damaging the plywood.¹⁵¹ Because of the low profile of the nail heads, the surface texture would not be affected.

¹⁴⁹ The term "Malarkey Shadowood" has been found in lumber trade journals and an issue of *Popular Science* from 1953. Produced by the M&M Wood Working Company, a very large organization and a pioneer in the fabrication of plywood from 1918 to 1956, Malarkey Shadowood was available "in both clear and knotty redwood with the soft grain wire brushed down". John Rogers, "Shopping for Plywood", *Popular Science* (September 1953), 215. See the National Register of Historic Places nomination form for the Herbert and Elizabeth Malarkey House for a brief history of the company: <http://pdfhost.focus.nps.gov/docs/NRHP/Text/05000827.pdf>.

¹⁵⁰ Portland Cement Association, *Forms for Architectural Concrete* (Chicago: Portland Cement Association, 1936), 36.

¹⁵¹ *Ibid*, 37.

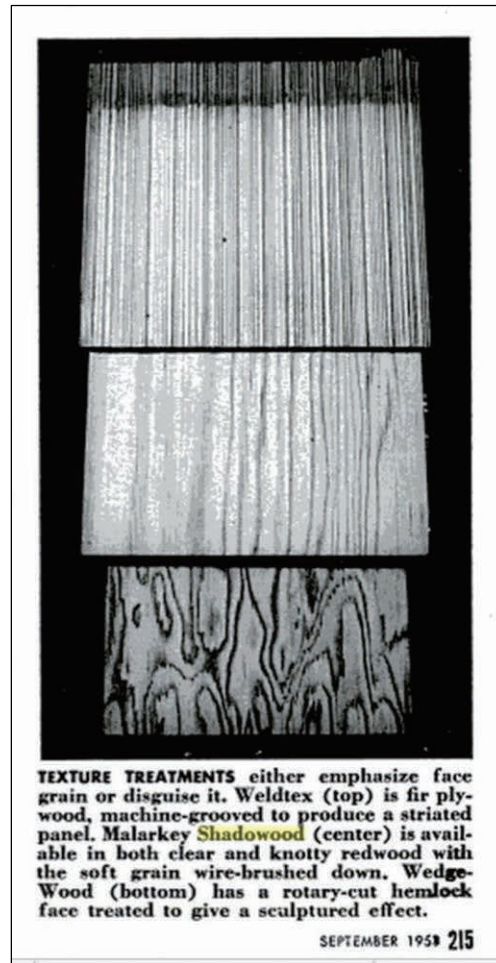


Figure 41: Illustration of plywood, including Malarkey Shadowood. Credit: *Popular Science*, September 1953.

Still, despite the beauty of the raised woodgrain texture, the bare concrete, form marks, and nails detracted from the uniform finish that Underwood ultimately desired. This was supplied by the finishing touch: color. Once again, Underwood employed a technique that he used at both the Ahwahnee and Sun Valley. Although acid stains were used on concrete from early in the 1920s, they were commonly used on floors or as a background for painted stenciling.¹⁵² This is partly due to the fact that the results are difficult to control: the

¹⁵² Francis S. Onderdonk, *The Ferro-Concrete Style: Reinforced Concrete in Modern Architecture* (New York: Architectural Book Co., 1928).

chemical reaction that creates the color takes place wherever calcium hydroxide (CH) exists. Because there can be varying concentrations of CH across the surface of the concrete, the colors will be darker in some areas but not in others. The resulting finish is mottled and variegated, similar to marble, hence the use of staining as a decorative finish for floors. Underwood may have been one of the first to specify acid stains for vertical surfaces or “flat work”.¹⁵³ This was described in a letter from the President of the Yosemite Park & Curry Co. (who had commissioned the Ahwahnee Hotel) to Thomas Vint, Chief Landscape Architect of the National Park Service, where he wrote

The concrete was first treated with a weak solution of muriatic acid. Copras [sic](commercial iron sulphate) was dissolved in water and applied to test samples of concrete until we got the proper shade of brown...Other colors at the Ahwahnee were purchased from a commercial company making a specialty of such acid stains.¹⁵⁴

The same procedure was followed at Jackson Lake Lodge, with acid stain colors provided by Kemiko, a manufacturer of acid stains and coatings since 1930 (Figure 42).¹⁵⁵ Underwood directed the application process, in which a base color of “Colorado Brown” was brushed onto the concrete surface. This was highlighted with black and tan colors to accentuate the texture of the woodgrain and complete the illusion of real redwood paneling.¹⁵⁶ A reference to this use of acid staining to mimic wood can be found in “Architectural Finishes: A

¹⁵³ Joe Nasvik, “Decorative Concrete Comes of Age”, *Concrete Construction*, (September 6, 2006), http://www.concreteconstruction.net/concrete-construction/decorative-concrete-comes-of-age_2.aspx.

¹⁵⁴ Dr. Don Tresidder to Thomas C. Vint, November 28, 1928, Folder 238, Box 1, Series 4: Executive Office, Subseries 3: Historical Files A, Collection 2001 Yosemite Park & Curry Co., Yosemite National Park Archives.

¹⁵⁵ Kemiko Concrete Products, Inc., “History of Kemiko”, 2015, <http://www.kemikostainforconcrete.com/history.html>.

¹⁵⁶ Gilbert Stanley Underwood to Rohloff & Co., Kemiko distributor, July 1, 1954, Folder 166, Box 14, Series Underwood Correspondence, Record Group Jackson Lake Lodge Project Authority 1954, Collection Grand Teton Lodge Company, Rockefeller Archive Center.

Roundup of Ideas and Techniques”, a collection of decorative concrete treatments from the magazine *Concrete Products*. The article describes the process of raising the grain of plywood to achieve a stronger woodgrain texture, adding “To further heighten the illusion of a wood finish, it is possible upon stripping [the forms] to stain the surface of the concrete brown by means of an acid”.¹⁵⁷ However, this was published in 1963, seven years after Underwood had already created his Shadowood at Jackson Lake Lodge.

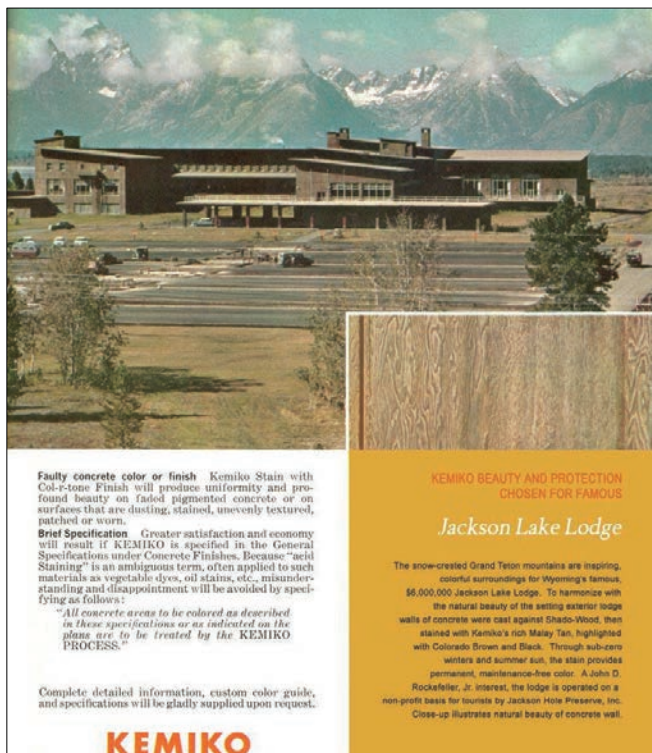


Figure 42: Advertisement for Kemiko acid stains featuring Jackson Lake Lodge, circa 1956. Credit: <http://www.kemikostainforconcrete.com/history.html>.

¹⁵⁷ Concrete Products, Ed., “Architectural Finishes: A Roundup of Ideas and Techniques” from *Concrete Products* (January-March, 1963), 13.

While the use of board-marked finishes and acid staining were fairly common practices in concrete construction, their use in combination across the entire surface of a structure was singular. Underwood utilized standard formwork to create an exposed surface texture for a building designed in the International Style that typically rejected applied decorative treatments of the exterior. However, the complexity of the formwork design and casting process was exploited for its decorative potential. The creation of a strong horizontality by using construction joints that served the dual purpose of aesthetics and practicality, honored the geometric design principles of the International Style (Figure 43). In this way, the design of Jackson Lake Lodge represents the intersection of the past and the future by using a modern style and construction material in a way that referenced traditional styles and materials. The Shadowwood that Underwood created at Jackson Lake Lodge is a character-defining feature and remains unique as a decorative expression in architectural concrete. Its conservation is essential to the preservation of this technique.



Figure 43: West elevation, circa 1960. Credit: Rockefeller Archive Center.

Chapter 3 - Condition Survey and Analysis

The preservation of modern architecture has presented a number of challenges to conservation professionals for many years due to the rapid evolution of building technologies, mass production (and then extinction) of a very wide range of building materials, and changes in standards and procedures. Addressing so many variables has made designing appropriate repair strategies quite complicated. In the case of architectural concrete buildings, “material authenticity and aesthetic authenticity are inseparable”¹⁵⁸, making repair strategies like patching, which alter the outward appearance of the concrete, a much more delicate matter. For this reason, the assessment and repair of architectural concrete buildings require careful planning and research, as an understanding of the design intention and construction methods will aid in better decision making than an analysis of the individual condition or deterioration mechanisms alone.

Ideally, this process should be preceded by an on-going maintenance program that is sensitive to the significance of the building. Because Jackson Lake Lodge has been continually operating since its completion in 1955, it has been regularly maintained. Following its designation as a National Historic Landmark in 2003, all changes to the building have been subject to review by the National Park Service and the State Historic Preservation Office. Still, a comprehensive conservation program does not currently exist for the Lodge. The following condition survey and analysis were undertaken as preliminary steps towards creating such a program.

¹⁵⁸ MacDonald, Susan, “Authenticity is More than Skin Deep: Conserving Britain’s Postwar Concrete Architecture”, “The Fair Face of Concrete: Conservation and Repair of Exposed Concrete”, *Proceedings International DOCOMOMO Seminar* (Eindhoven: Eindhoven University of Technology, 1997), 48.

3.1 Condition Survey

Archival research and a site visit was conducted during the week of March 15 to March 21, 2015 in Jackson Hole, Wyoming and Jackson Lake Lodge in Grand Teton National Park. The primary purpose of the site visit was to conduct a condition assessment of the exterior of the Lodge, in order to confirm the construction details observed on the drawings and to identify deterioration mechanisms, if any. The assessment was a visual survey of the exterior of the Lodge, performed by walking around the perimeter of the building and recording observations through note-taking and photography. This was a qualitative survey; no on-site testing or calculations were performed. Samples of concrete were collected from areas of the building that could be considered representative of the decorative surface finish and of any conservation issues, to be examined upon return to Philadelphia.

The first part of the survey consisted of seeking out and confirming the construction details observed in the architectural drawings. Despite the presence of certain information and dimensions included in specifications and on drawings, there is no guarantee that the existing building was constructed exactly as described. Specifically, archival research did not result in a description of how the Shadowood was created, so this needed to be supplemented by observations made onsite. Based on archival information, Jackson Lake Lodge is a steel-framed structure with ten-inch thick reinforced concrete partitions, concrete slab floors, and cantilevered composition roofs. The building is supported by 124 concrete filled piles driven into the hilltop, due to the discovery of pumice during the

excavations for the foundation.¹⁵⁹ As far as can be determined nearly all of the reinforced concrete elements were cast in place, made possible by the presence of a batch plant onsite that facilitated greater control over proportioning, mixing, and placing. This was a critical component for the timing of the placement of each lift of concrete because it could be controlled more closely than if each batch of concrete had to be delivered from elsewhere. Typically, concrete is conveyed in a truck from the plant to the worksite. Delays in the delivery due to traffic, slow site working conditions, and other factors, can result in a mixture that is already beginning to set by the time it is ready to be placed. The difference in fluidity between the concrete that has already been placed and the next layer is often made visible by a line, called a construction or “cold” joint, demarcating the two lifts. Though unsightly, if they are not well-hidden, these joints can help in forming an understanding of how the building was constructed. Wall-construction and detailing is a key component of the creation of the Shadowood, so more time was spent examining this aspect of the construction of the Lodge than others during the site visit. Other factors considered during the assessment included features such as drip edges that affect how water is shed from the building, and alterations to the original design that might have had an impact on the durability of the concrete.

Overall, the results of the condition assessment were quite positive. Certain elevations seemed to be faring worse than others, but conditions on these elevations were typically concentrated only in a few areas. The Shadowood continues to maintain its woodgrain texture, however the color has been changed significantly, resulting in a very different appearance than was originally intended. In general, the concrete appeared to be

¹⁵⁹ Harold P. Fabian to Kenneth Chorley, July 22, 1953, Folder 346, Box 30, Record group IV 3A7.2, Harold P. Fabian Papers, Teton Company, Rockefeller Archive Center.

performing well: no major areas of spalling or loss were observed and the most prevalent issues identified were cantilever efflorescence, cracking and minor spalling related to water infiltration and alterations. Primarily, these issues are related to weathering, as defined by the American Concrete Institute's *Concrete Terminology*¹⁶⁰:

- *Weathering*: "changes in color, texture, strength, chemical composition or other properties of a natural or artificial material due to the action of the weather"
- *Cracking*: "a complete or incomplete separation of either concrete or masonry into two or more parts produced by breaking or fracturing"
- *Efflorescence*: "a generally white deposit formed when water-soluble compounds emerge in solution from concrete, masonry, or plaster substrates and precipitate by reaction such as carbonation or crystallize by evaporation"
- *Spall*: "a fragment, usually in the shape of a flake, detached from a larger mass by a blow, the action of weather, pressure, or expansion within the larger mass"

Each of these types of weathering were also identified in a condition assessment performed in August 2014 by Jorgensen Associates, PC, a structural engineering firm local to Jackson Hole.¹⁶¹ In their report it was presumed that the conditions caused by weathering were exacerbated by water infiltration due to a failure of the roofing membrane, suggesting that the roofing materials had reached the end of their service life.¹⁶² During the site visit in March 2015, a significant amount of water was observed running off of the building due to

¹⁶⁰ American Concrete Institute, *ACI Concrete Terminology: An ACI Standard, ACI-CT13* (Farmington Hills: American Concrete Institute, 2013).

¹⁶¹ Jason Mann, *Jackson Lake Lodge: Structural Concrete Condition Assessment* (Jackson Hole: Jorgensen Associates, PC, 2014).

¹⁶² *Ibid*, 2.

melting snow, which clearly demonstrated that the quality of the roofing materials directly impact the ability of the building to resist water infiltration.

East Elevation and Porte-Cochere¹⁶³:

The primary entrance to Jackson Lake Lodge is beneath the porte-cochere on the east elevation (Figure 45). It is nine bays long and two bays deep, with concrete piers dividing each bay. The piers, ceilings, and beams all feature the Shadowood woodgrain imprint and rustication joints, but have been heavily overpainted. The piers and beams have been painted a dark brown, while the ceiling bays are cream-colored (Figure 46). The entrance wall is marked with rusticated ashlar sandstone with recessed joints, flanking the brass-framed, double glass doors. A central hanging light fixture and six wall sconces date from sometime after 1956. The original lights were recessed into the ceiling and soffit. Though they have been removed, square wood panels indicate their former locations (Figure 44).

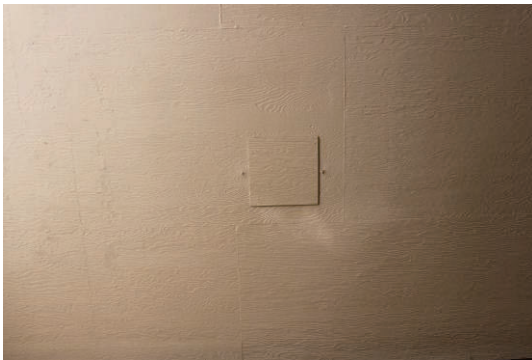


Figure 44: Detail of square ceiling panel where original light fixture has been covered over. Credit: Author, 2015.

¹⁶³ Access to this area was somewhat limited, due to the presence of lodge vehicles parked beneath porte-cochere for winter storage.



Figure 45: Porte-Cochere as seen from parking lot, enclosed for the winter, 2015. Credit: Author.

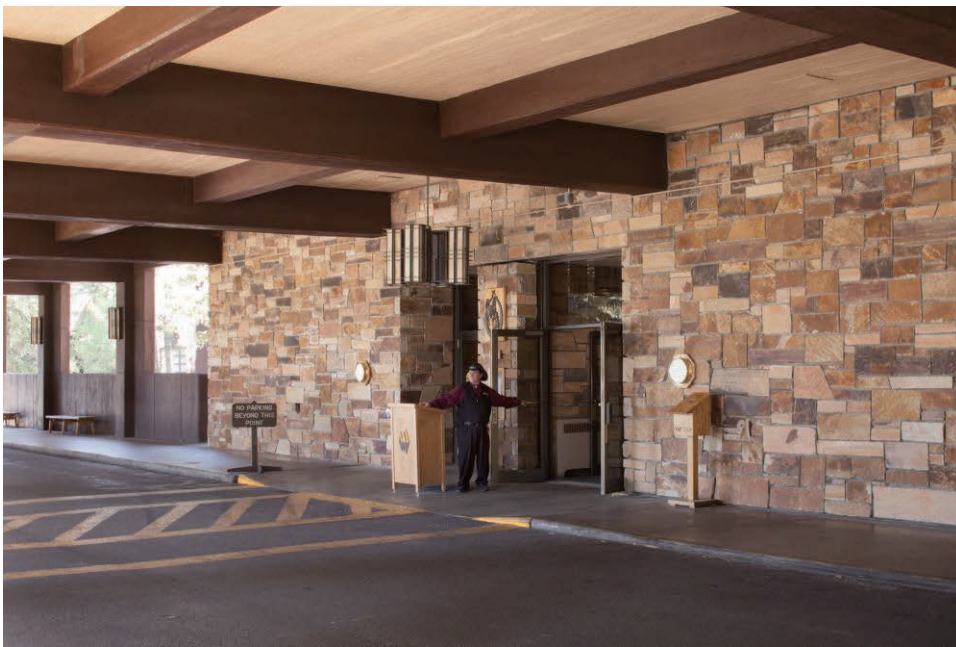


Figure 46: Beneath porte-cochere, facing main entrance, 2014. Note non-original hanging lights and wall sconces. Credit: Joe Elliott.

Condition:

The piers and beams of the porte-cochere are in very good condition, besides the overpainting. However, there is some evidence of moisture migration from the roof, which also doubles as the sun deck. Two of the ceiling bays on the south side of the porte-cochere display cracking, efflorescence, and iron staining (Figures 47, 48). Along the soffit, hairline cracks with efflorescence are visible every ten feet or so, which could indicate the location of the reinforcing bars. Some of these cracks appear to have been filled and re-painted with a different color than the rest of the soffit (Figure 49). There is a drip edge, which helps shed rainwater and snow melt, but will not have an impact on the migration of water from the sun deck. However, overall the concrete of the porte-cochere is performing very well.



Figure 47: Hairline cracks, efflorescence, and iron staining in a ceiling bay of the porte-cochere. Credit: Author, 2015.



Figure 48: Detail of ceiling bay condition. Credit: Author, 2015.

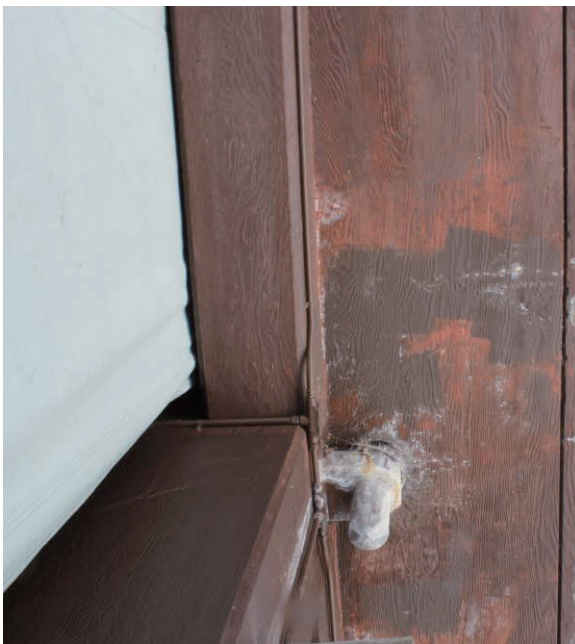


Figure 49: Detail of porte-cochere soffit illustrating hairline cracks and over-painting. Credit: Author, 2015.

East/South Elevation:

The east elevation continues towards the south and houses the kitchen wing and the employee dining room. The kitchen wing is located on the first floor in a façade-long

rectangular space that projects out horizontally from the second floor, which holds guest rooms (Figure 50). The south side of the east elevation terminates in the employee dining room, which is two-stories in height and extends northward towards the porte-cochere (Figure 51).



Figure 50: East elevation with kitchen wing on left, 2015. Credit: Author.



Figure 51: Employee Dining Room, exterior, 2014. Credit: Joe Elliott.

Condition:

In general, the soffit of the second storey is in very good condition along the entire length of the east elevation and the employee dining room, as far as could be observed from the ground. In contrast, the first storey soffit is in much worse condition, displaying many hairline cracks and efflorescence (Figure 52). This is also the case on the underside of the balcony that leads from a door on the second storey to the sun deck (Figures 53, 54). As an exposed slab, no protection from moisture migration has been provided on the balcony. Again, hairline cracks appear at regular intervals, suggesting they correspond with the placement of reinforcing bars, and efflorescence is evident at each one. The surface of the balcony is also cracked. A piece of the underside of the balcony recently fell off, suggesting that its overall condition is poor. The area of loss has since been filled and patched, but this is only a temporary solution for what appears to be a much larger issue. As the balcony is above the bicycle storage racks, its condition poses a threat to both employees and visitors.



Figure 52: East elevation, kitchen wing. Note differences between soffits of first and second stories. Credit: Author, 2015.



Figure 53: Balcony on east elevation displaying hairline cracking and efflorescence. Credit: Author, 2015.



Figure 54: Detail of hairline cracking and efflorescence on underside of balcony, east elevation. Credit: Author, 2015.

South Elevation/Service Yard:

The south elevation is made up primarily of the service yard, which includes the entrance to the maintenance shops, the loading dock, refuse storage, and tool sheds. The concrete in this area was formed with a board-marked finish, instead of the Shadowood treatment seen on the rest of the building. All areas appear to be performing well, only a few cracks and efflorescence was observed.



Figure 55: Service yard, south elevation. Credit: Author, 2015.

Condition:

The former incinerator and boiler room chimney stacks are also located on the south elevation. From the ground, it appears that these are in poor condition, with areas of loss in the concrete and rusting of the spark cage and metal louvers. The color of the wall panels beneath these louvers is uneven and lighter than the surrounding area (Figure 56). At the intersection between the service yard wall and the western side of the south elevation, the first storey soffit shows a significant amount of efflorescence (Figure 57). Though not in the public view, it is evidence of a greater issue that is affecting all other parts of the building.



Figure 56: Detail of uneven lightening of wall coloring and areas of loss on base of spark cage. Credit: Author, 2015.



Figure 57: Significant efflorescence at soffit and wall juncture. Credit: Author, 2015.

West Elevation:

The west elevation faces the Grand Teton mountain range and includes the Mural Room restaurant, guest rooms on the second storey, the picture windows of the main lounge, The Blue Heron Bar, and the Explorer Room extension. It offers the clearest expanse of Shadowwood found on the entire building (Figures 58, 59).



Figure 58: (above) West elevation. Figure 59: (below) West elevation, looking north. Credits: Joe Elliott, 2014.



Condition:

Overall, the concrete on the west elevation is in very good condition. General map/temperature cracking can be observed across the facade, and it typically runs the entire length or width of the concrete panels (Figures 60, 61). Localized areas of the base show disaggregation from water saturation and probably freeze-thaw damage (Figure 62). The soffit appears to be in good condition, although there are a few hairline cracks and accompanying efflorescence. There are also cracks extending from the corners of the sills and heads of nearly every window on all stories. These can most likely be attributed to the fact that all of the windows on this elevation have been changed at least once over the past fifty years. The changes were not limited only to different glazing or framing. For example, the guest room windows were enlarged, disrupting the grid pattern and necessitating the installation of new lintels that were given a masonry-like finish, which is incongruous with the surrounding Shadowood (Figure 63).



Figure 60: Southern end of west elevation illustrating general conditions. Credit: Author, 2015.



Figure 61: Detail of temperature crack extending from window sill. Credit: Author, 2015.



Figure 62: Detail of areas of disaggregation on sill base. Credit: Author, 2015.



Figure 63: Detail of window on west elevation illustrating general conditions including inappropriate head and sill repairs and thermal cracking. Credit: Author, 2015.

North Elevation:

Access to this elevation was limited by a large amount of snow. The areas that were visible appeared to be in good condition, with losses and patching limited to the ground floor entrance to the convention hall meeting rooms. Otherwise, the concrete on the north elevation is in better condition overall than that of the other elevations. This could be due to the limited number of alterations on this elevation, as well as the fact that the trees grow more closely to this façade, shading it and protecting it from the wind. It may also experience fewer cycles of freeze-thaw given its north exposure.

See Appendix B for additional images from condition assessment.

Conclusion

The concrete on the south elevation and the south side of the east elevation seems to be faring the worst, though this is still limited to hairline cracks and efflorescence. Their prevalence could be due to the higher number of freeze-thaw cycles and thermal movement on this side, causing cracking and allowing greater water infiltration from the roof. While water is not a cause of deterioration in and of itself, it activates associated deterioration mechanisms such as rebar corrosion and spalling.

Although the exterior concrete at Jackson Lake Lodge appears to be in very good condition, it is nevertheless important to anticipate a time when this might not be the case. While structural issues are of the greatest concern in terms of the safety of employees and visitors, there is a question of how to treat the Shadowood in the event of damage or loss. There are not always easy or straightforward approaches to repairing character-defining features of concrete, especially because they are often so integral to the material and to the identity of the building. This has already been seen in the changes to the guest room windows and the addition of the Blue Heron Bar on the west elevation. The choices available are typically one of three options: replacement in the form of replication; replacement with a completely different appearance; or replacement with something that falls in-between. Forming the concrete with woodgrain, whether Shadowood or another version, would be important but the greater challenge could lie in selecting an appropriate color and coloring method. This has already been addressed to some degree, due to the fact that the Lodge was re-finished fifteen years ago. An investigation and analysis of the original coloring process was undertaken to understand more clearly the original design intention and how the Lodge will be affected by using something different.

3.2 Instrumental Analysis

The original coloring process on the exterior concrete at Jackson Lake Lodge was acid staining. This is included in the building specifications, as well as mentioned by Underwood in some of his correspondence: “Our hope has been to get the naked concrete showing through a very dark brown stain similar to the stain used...at Sun Valley and on the Ahwahnee Hotel at Yosemite National Park”.¹⁶⁴ Underwood used three different stain colors on the Jackson Lake Lodge Shadowood: “Colorado Brown”, “Black”, and “Malay Tan”. He procured these stains from Kemiko, a company that had been producing acid stains and other concrete products since 1930.¹⁶⁵ Acid stains are sold as liquid solutions that are typically composed of inorganic, water-soluble metallic salts, such as iron chloride, copper, and manganese, hydrochloric acid, and water. The hydrochloric acid lowers the pH of the acid stain solution, and as it is applied, the acid slightly etches the surface of the concrete so that the water and metallic salts can penetrate more easily. The acid is neutralized as it reacts with the calcium hydroxide in the concrete. Acid stain colors are produced when the metallic hydroxides or oxides precipitate out of the solution and become solids, bringing out the finished color. The reaction moves from water-soluble chlorides or sulphates to insoluble oxides, hydroxides, or carbonates. Acid staining is so-called because of the presence of hydrochloric acid, but this is not required for the colors to form. A solution of metallic salts and water produces the same reaction and is used when the surface of the concrete is already porous enough for the solution to penetrate. Because Underwood had

¹⁶⁴ Gilbert Stanley Underwood to Rohloff & Co., July 1, 1954, Folder 166, Box 14, Underwood Correspondence, Jackson Lake Lodge Project Authority 1954, Grand Teton Lodge Company, Rockefeller Archive Center.

¹⁶⁵ Kemiko Concrete Products, Inc. “History of Kemiko”, <http://www.kemikostainforconcrete.com/history.html>.

used acid staining in his projects before, he directed their application at Jackson Lake Lodge.¹⁶⁶ Each color was brushed onto the surface of the Shadowood and then allowed to dry before the next color was applied. If the next color been applied while the first layer was still wet, the colors would have blended and possibly have become muddied.¹⁶⁷ While spraying is the most common way to apply acid stains, brushing allows for better control of the location of the stain as well as reducing or eliminating any drips. In this way, Underwood was able to highlight certain areas of the woodgrain texture, enhancing the illusion of a real wood panel. After the final application of staining, the concrete was sealed with a protective coating that produced a matte finish on the surface.¹⁶⁸

A large area of original Shadowood finish was enclosed above the Blue Heron Bar when it was added in 1988 (Figures 64, 65). There, it is possible to see what the concrete looked like after thirty years of exposure. The resemblance to weathered wood is remarkable, and demonstrates Underwood's skill with formwork and acid staining. There are no drips, and although some areas have lightened more than others, it is still possible to get a sense of how Underwood planned for the concrete to look. The brown base color and black highlighting now has a grey tone, which is in stark contrast to the current color of reddish-brown; however early colored views of the Lodge suggest the color was redder than it now appears in this protected area. The original acid stain remained on the Lodge until about the

¹⁶⁶ Gilbert Stanley Underwood to Kenneth Chorley, August 2, 1954, Folder 166, Box 14, Series Underwood Correspondence, Record Group Jackson Lake Lodge Project Authority 1954, Collection Grand Teton Lodge Company, Rockefeller Archive Center.

¹⁶⁷ Concrete Décor, "Layering Acid Stains", *Concrete Décor: Journal of Decorative Concrete* 5, No. 2 (April/May 2005), <http://www.concretedecor.net/decorativeconcretearticles/vol-5-no-2-aprilmay-2005/layering-acid-stains/>.

¹⁶⁸ "We understand that M-K will develop a date on a 'sealer' for the exterior acid stained walls...The finish should be dull and flat with no hint of grease or polish", Memorandum to Morrison-Knudsen, March 25, 1954, Folder 166, Box 14, Series Underwood Correspondence, Record Group Jackson Lake Lodge Project Authority 1954, Collection Grand Teton Lodge Company, Rockefeller Archive Center.

year 2000, when it was re-colored by a coatings company that specialized in staining vertical surfaces (Figure 66). Without the discovery of the original finish, it would have been very difficult to visualize how it would have appeared before 2000, since the exterior was stripped before the new color was applied (Figure 67).



Figure 64: (above) Original Shadowwood enclosed above Blue Heron Bar. Figure 65: (below) Detail of original Shadowwood. Credits: ACL, 2015.





Figure 66: Detail of Shadowwood with color from 2000. Note uniformity of color and lack of highlighting. Credit: Author, 2015.



Figure 67: Detail of stripped original stain next to current coloring. Credit: Author, 2015.

To prepare the surface for re-coloring, the coatings company took several steps: first, they applied a cleaning product on the concrete (not specified), then mechanically washed the surface, followed by power water washing. They then acid etched the surface and power washed it once again.¹⁶⁹ It is unclear why the coatings company chose to acid etch the surface of the concrete prior to re-coloring. The acid in acid stains is used primarily to react with the calcium carbonate and calcium hydroxide and slightly etch the surface of the concrete lowering the pH enough to enable the solution of water and metallic salts penetrate.¹⁷⁰ Because the metallic salts produce color by reacting with the calcium hydroxide (CH), acid etching is typically not recommended because it depletes the amount of CH available for reaction.¹⁷¹ The finish treatment used in 2000 was probably a water-based (not acid) stain, as evidenced by the brightness of the color.¹⁷² These stains use acrylic polymers and pigments to color the concrete and are available in a much wider palette than traditional acid stains.¹⁷³ Following the application of the new color at Jackson Lake Lodge, the surface was coated with two coats of sealer (unspecified).¹⁷⁴ As a result, the concrete now has a thin, colored surface coating rather than the integral applied colored surface of the original treatment.

Fifteen years have passed since the exterior Shadowood was re-colored, and the stain is showing signs of weathering and wear. Though the original color on the exterior of the

¹⁶⁹ Harry L. Power to Allen Elzay, May 26, 2000, copy of staining bid courtesy of Lori Cornell, files of Grand Teton Lodge Company.

¹⁷⁰ Joe Nasvik, "Using Acid Stains", *Concrete Construction*, December, 2009, <http://www.concreteconstruction.net/concrete/using-acid-stains.aspx>.

¹⁷¹ Ibid.

¹⁷² The exact product used in 2000 is unknown. The only information found so far that refers to the re-coloring is a bid for the work from Superior Coatings, Inc.

¹⁷³ Concrete Network, "Stained Concrete: The Art of Acid-Etch Staining", <http://www.concretenetwork.com/stained-concrete/>.

¹⁷⁴ Harry L. Power to Allen Elzay, May 26, 2000, copy of staining bid courtesy of Lori Cornell, files of Grand Teton Lodge Company.

building was fairly uniform overall, this is no longer the case with the newer applied finish due to several factors. For example, wherever the stain has come into contact with flowing water it appears faded and, quite literally, washed out. Areas of patching have been painted over with a subsequent dark brown, opaque wood stain¹⁷⁵, which is also used to maintain the low walls surrounding the patio and Blue Heron Bar on the west elevation. In this one intersection of walls from the Bar, Lodge, and patio, three distinct shades of brown can be identified, making for a disjointed visual effect (Figure 68). As part of an on-going maintenance program, another re-coloring of the Lodge is being considered and will probably take place within the next few years.



Figure 68: Detail illustrating the three different colors of the Lodge, Blue Heron Bar, and wall. Credit: Author, 2015.

The current color of Jackson Lake Lodge has been considered satisfactory for about fifteen years. With an anticipated service life of approximately ten to twenty years, it can be

¹⁷⁵ Interview with Tom, Jackson Lake Lodge Painting Supervisor, March 13, 2015.

expected that the Lodge will undergo several more re-colorings in the future. Although the formulation and application procedure of acid stains has changed little within the past 150 years or so, an understanding of the constituents, behavior, and performance of all layers of historic coatings will inform the selection of those that follow. To this end, samples of the original acid stain and of the stain from 2000 were examined and characterized using instrumental analysis.

In order to determine which instruments to use, two questions were identified: what is the distribution of elements common to the acid stain, when compared with the surrounding concrete, and what is the depth of penetration of these elements? To provide the answers, optical microscopy, elemental analysis using X-Ray Fluorescence (XRF), and Energy Dispersive Spectroscopy (EDS) elemental mapping with Scanning Electron Microscopy (SEM) were selected as methods of examination. Samples had been collected during the March 2015 site visit: one of concrete with original finish and one with the current color, and sample solutions of acid stain were obtained from Kemiko. These were prepared for examination by making a thin section from the sample with the current finish and taking a cross section of the original finish. The composition and condition of the concrete were not examined with these instruments beyond basic characterization. The primary interest was the acid stain.

Optical Microscopy

Initially, the only sample available for analysis was a piece of concrete that had fallen from the underside of the balcony that leads to the sun deck on the east elevation (Figures 69, 70). The primary surface coating appeared to be the stain from 2000, but there were also splotches of white that could be from some type of mastic (definitely not stain or paint). The

sample was further complicated by an area of patching on which a very different material than the concrete substrate had been used. A thin section was made from this sample and examined using the B-31 Polarizing Light Microscope in the Architectural Conservation Laboratory at Penn Design.



Figure 69: (above) Location of sample on underside of balcony, east elevation. Figure 70: (below) Concrete sample from balcony. Credits: Author, 2015.



Objective: To characterize the concrete substrate and to observe the depth of penetration of acid stains.

Procedure: The thin section was examined under plane polarized light (PPL) at magnifications of 4x, 10x, and 20x.

Observations:

- The concrete matrix is made up of cement paste and aggregates. Overall, the matrix appeared to be very porous, as there were many discontinuities between paste and aggregates (Figure 71). The cement paste appeared quite dark, with small black inclusions. The aggregates could be classified as rounded to subrounded, and were well-sorted but not very well graded, as most were of the same size. No mineralogical analysis was performed on the aggregate. At least three distinct layers could be observed at the surface of the sample (Figures 72-74). The topmost layer was very thin and even, and ran the entire length of the thin section. This most likely indicates a layer of soiling due in part to its uniformity and opacity. The second layer is a bright, white band that occurs along most of the length of the surface but at varying thicknesses. This is most likely laitance (see Glossary), as it is made up of tiny crystals that have been identified as calcite due to their high order interference colors. The third layer appears both above and below the layer of laitance and is most likely more of the concrete matrix, due to the presence of the same small black inclusions observed in the cement paste.

These observations helped to characterize a sample of concrete from an area of Jackson Lake Lodge that is currently in poor condition. The high porosity of the sample indicates that the cohesion of the matrix is tenuous, which could be part of why this sample became detached from the rest of the balcony. This analysis did not result in an estimate of the depth of penetration because the stain could not be identified.

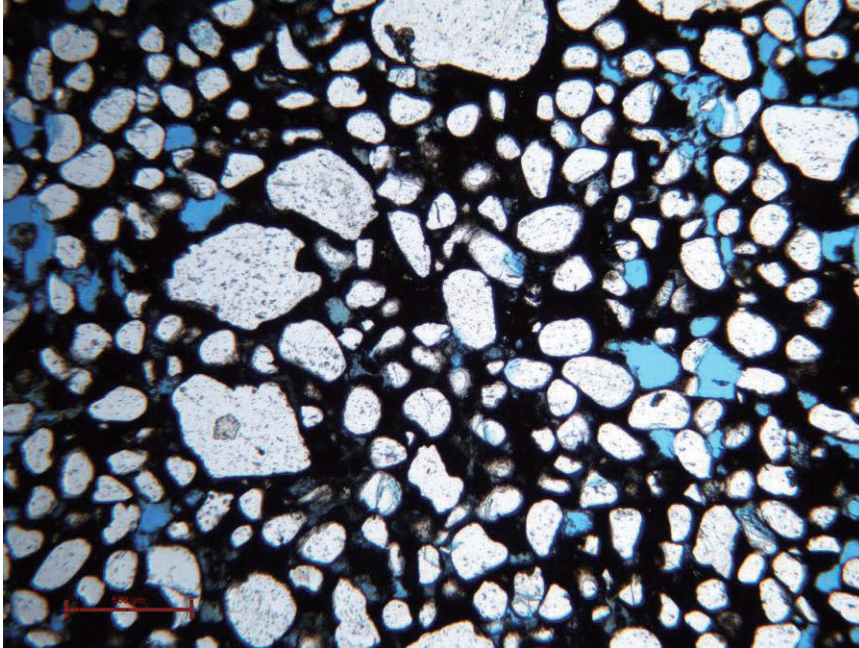


Figure 71: Concrete matrix at 4x magnification, plane-polarized light. Credit: Author, 2015.

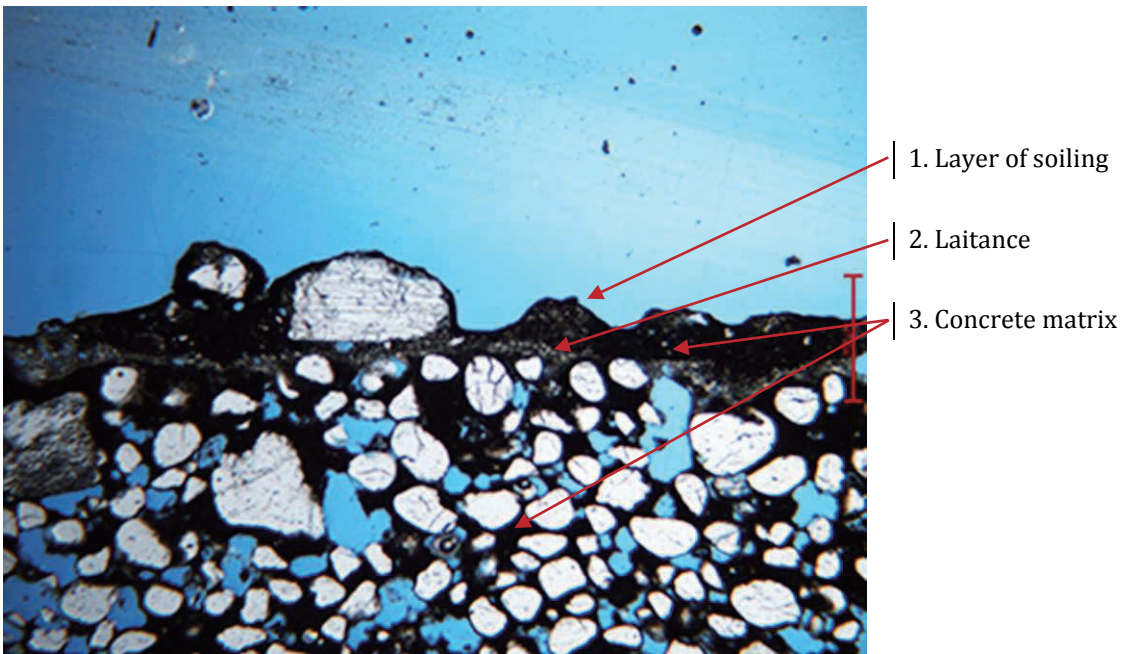


Figure 72: Layering at surface of thin section at 4x magnification, plane-polarized light. Credit: Author, 2015.

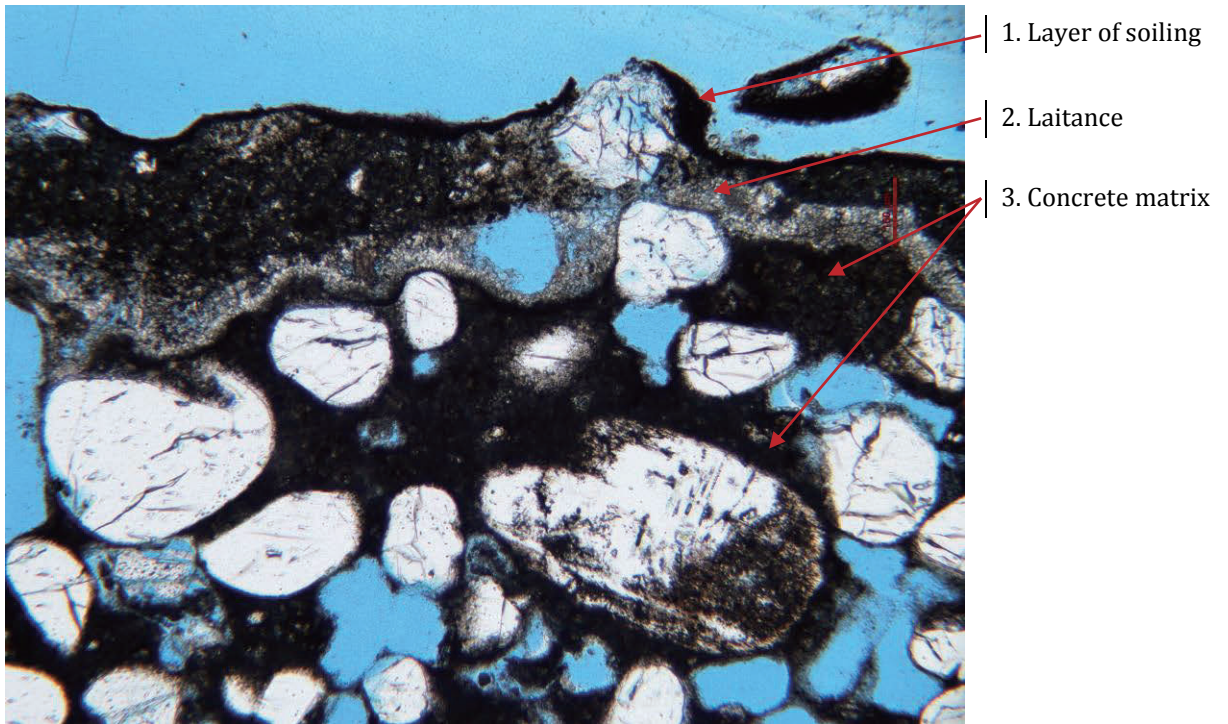


Figure 73: Detail of surface layers at 10x magnification, plane-polarized light. Credit: Author, 2015.

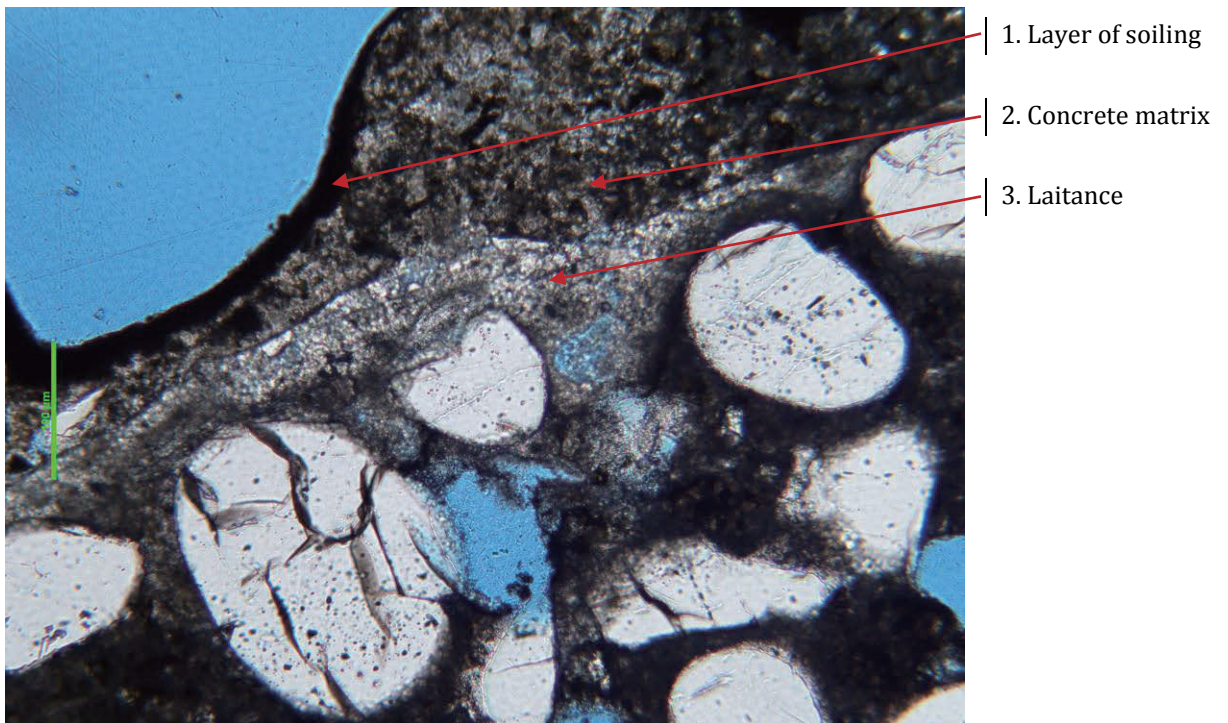


Figure 74: Surface layers at 20x magnification, plane-polarized light. Credit: Author, 2015.

X-Ray Fluorescence (XRF) Spectrometry

Equipment: Portable Bruker Tracer III SD X-Ray Fluorescence machine

Samples: Five samples were examined and included a piece of concrete with the original stained surface (1), a sample of concrete stained with Kemiko color Malay Tan (2), a sample of concrete with the current (2000) stained surface (3), and two more samples of concrete stained with Kemiko colors Cola and Black (4, 5), (Figures 75-79). As a reference standard, drops of acid stain solutions for each of the Kemiko-produced colors were placed on glass microscope slides and their spectra were also recorded.

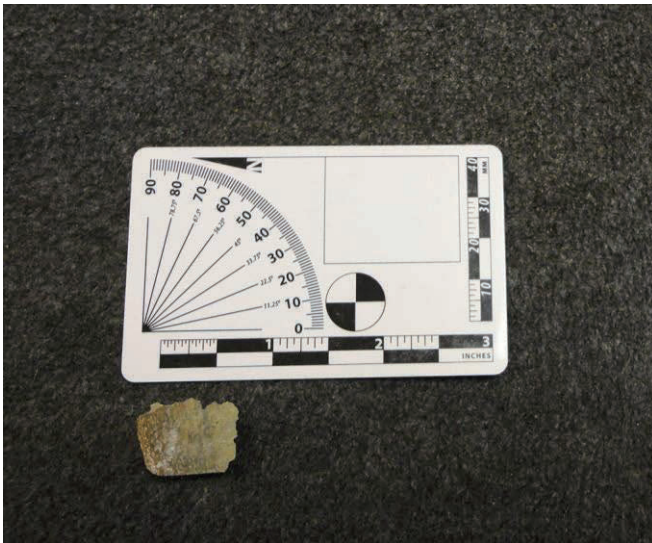


Figure 75: Sample of concrete with 1955 acid stain. Credit: Author, 2015.

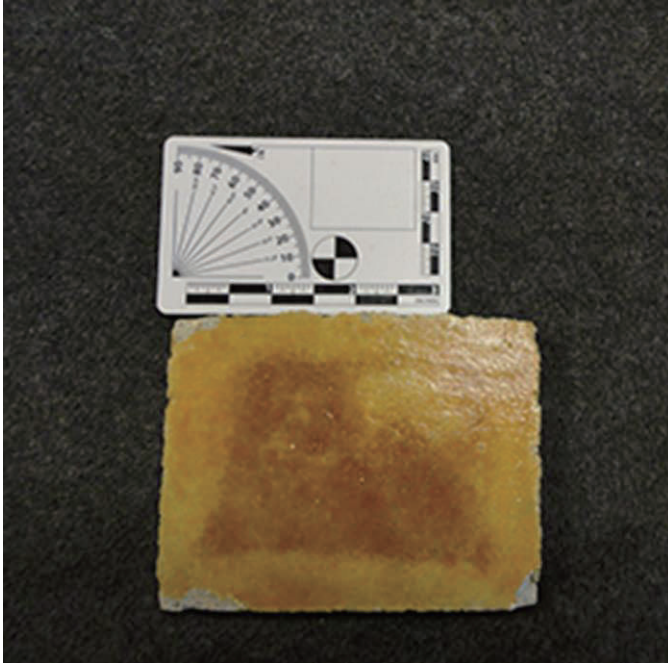


Figure 76: (above) Acid stained concrete sample from Kemiko in color Malay Tan. Figure 77: (below) Sample of concrete with current colored surface. Credits: Author, 2015.

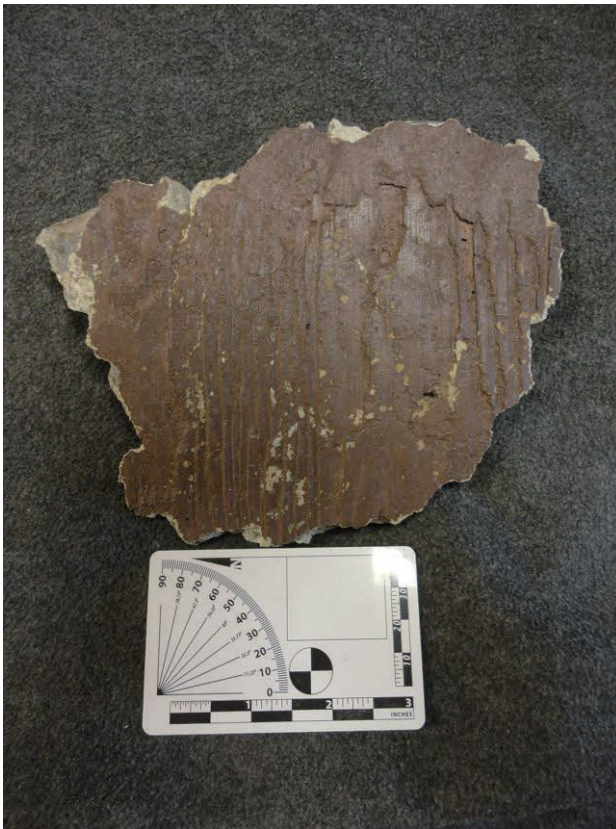




Figure 78: (above) Acid stained concrete sample from Kemiko in color Cola. Figure 79: (below) Acid stained concrete sample from Kemiko in color Black. Credit: Author, 2015.



Objective: To identify whether any difference between the elemental composition of the stained surface of the sample and the un-stained side of the concrete could be detected.

Procedure: Each of the five samples were placed on the tray on top of the portable XRF machine and covered with the lead cap. Spectra were produced for both sides of Sample 1 and Sample 2, but only for the stained side of all the other samples. The resulting spectra were analyzed for the presence of iron (primarily) and manganese. Spectra from each sample were compared with each other and with the standards to facilitate analysis.

Observations:

- Because the primary element used to produce the color in the acid stains for Jackson Lake Lodge is iron (Fe), it is possible that a higher concentration of this element would be present on the stained surface of the original sample than on the un-stained side. However, the iron peaks in the spectra for both sides was fairly similar (Figures 80, 81). This similarity could be due to a number of factors including the fact that the sample had weathered for about thirty years, that the uneven topography of the un-stained side made it difficult for the machine to take a clear reading, and that the sample was not representative of the stained finish.

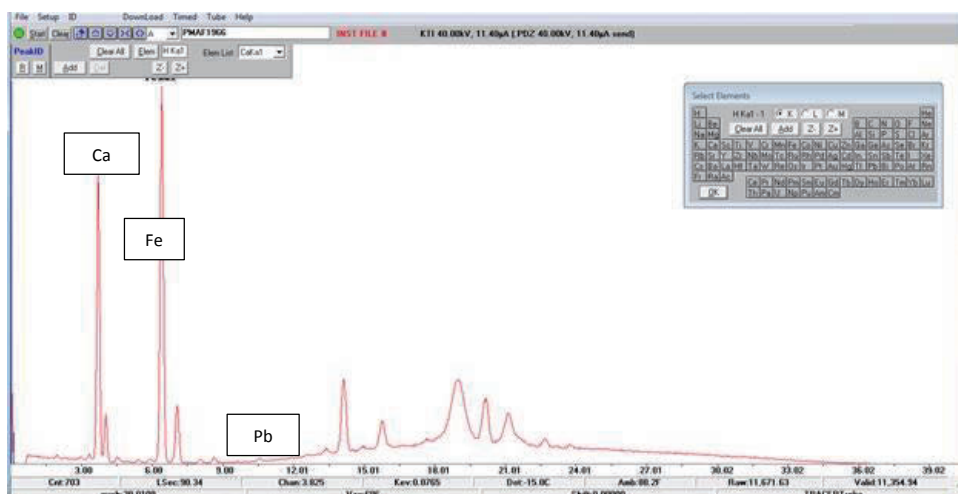


Figure 80: Spectrum for concrete sample with original acid stain.

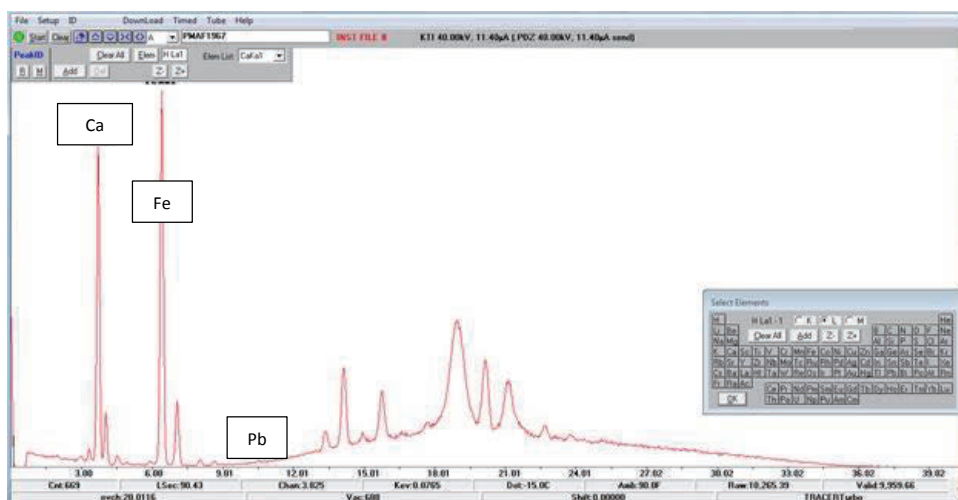


Figure 81: Spectrum for the concrete-only side of the original acid stained sample.

- In the spectra for the newly stained concrete samples, there were appreciable differences between the stained side and the unstained side (Figure 82). Sample 2 displayed a strong iron peak on the stained side compared with the reverse, as well as more calcium (Ca), which can be attributed to the fact that much more calcium carbonate and calcium hydroxide are present in fresh concrete. Still, a strong difference between the two sides was not observed, and could be affected by the

depth of penetration of the beam, which could be reading signals from the concrete substrate instead of only the layer of stain.

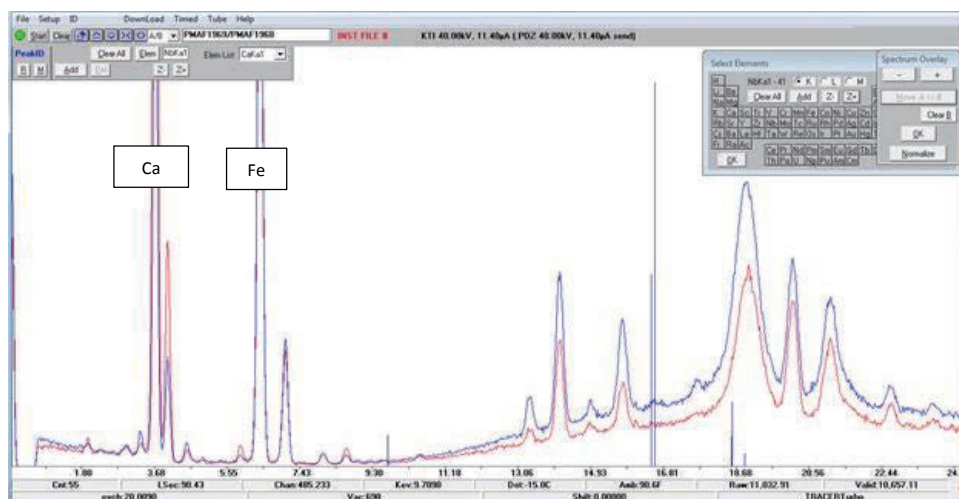


Figure 82: Comparison of spectra for stained and un-stained sides of sample of Kemiko Malay Tan. Red lines are concrete side, blue lines are stained side.

- The composition of the stain used on the sample from 2000 is unknown, but its spectrum did not differ greatly from the other samples except that less iron was identified.
- Samples 4 and 5 had strong peaks of iron and manganese (Mn), which were to be expected because of Sample 4's reddish-brown color and Sample 5's black color.
- See Appendix B for more images related to this analysis.

The results of this analysis were inconclusive. A more pronounced difference between the peaks of iron on the stained surface of the original finish sample and the un-stained surface was expected, but was not observed. However, the strong presence of iron on the stained side of the newly colored samples suggests that weathering has had an effect on the original stain. Because acid stains are integral to the concrete, they are not typically affected by UV degradation or other types of weathering. Yet with the eventual erosion of the sealer, some changes in the stain could be expected over time.

Energy Dispersive Spectroscopy (EDS)

Equipment: FEI Quanta 600 FEG Mark II Environmental Scanning Electron Microscope

Sample: Cross-section of concrete with original acid stained surface finish, cut with 15 CL diamond blade on Isomet Low-Speed Saw with Stoddard oil as lubricant

Objective: To map the elemental distribution

Procedure: The sample was secured to the stage inside the SEM/EDS machine with the cut side facing upward. Parameters were set as follows: low vacuum; Voltage, 15.0 kV; spot size, 5.0; WD, 10.0 mm; magnification, 70x. The area to be mapped was set at about 3mm (~0.12 inches) square. The sample was mapped in three passes (Figures 83-86): the first included the stained surface of the sample and some of the substrate; the second was the middle of the substrate; and the third was the base of the substrate. Each pass lasted for 22, 33, and 26 counts of mapping, respectively, out of a possible 256. The passes were brief because the amount of information desired was gathered fairly quickly and because of time constraints for using the machine.

Observations: Since the color of the acid stain was made using iron, there was a good chance that this element would be concentrated near the surface of the sample. However, in all three passes, iron made up only about 1% of the total elements mapped in each area and was distributed throughout, instead of being concentrated. Some small points of concentration were identified, but these could be attributed to aggregates. With a typical depth of penetration of about 1.6mm – 0.8mm (1/16" to 1/32"), it would be unusual to see elements of acid stains distributed so evenly throughout a 3mm area. The results of these observations were therefore also inconclusive.

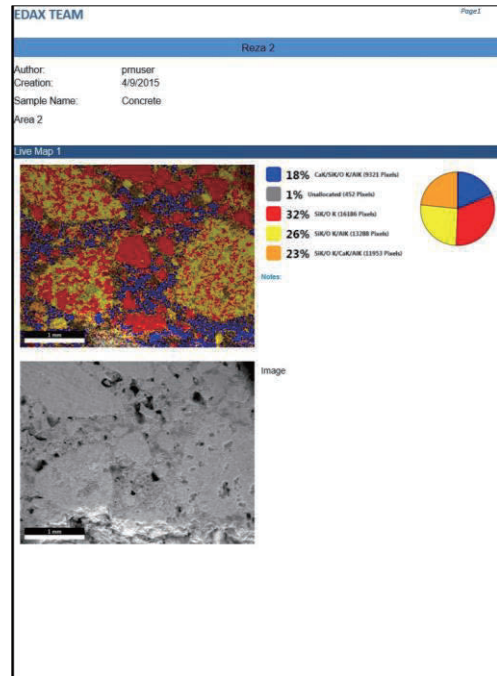
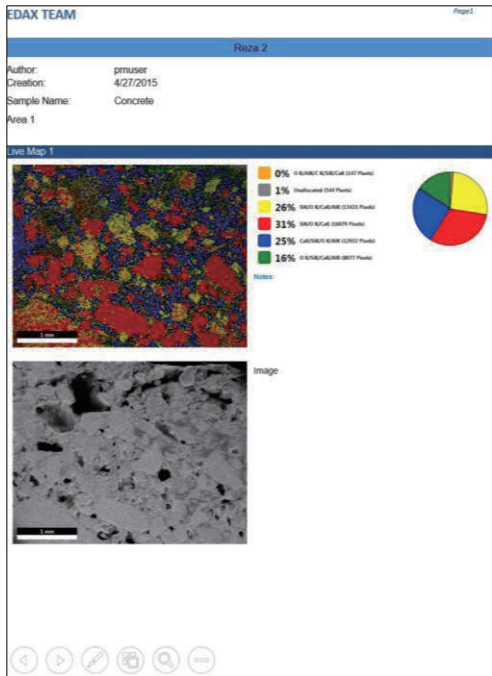


Figure 83: (left) Overview of elemental map of Area 1 - first third of substrate with acid stained surface at the top of the image. Figure 84: (right) Overview of elemental map of Area 2 - middle third of substrate.

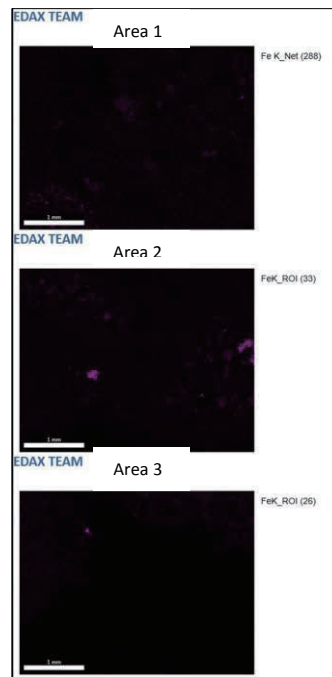
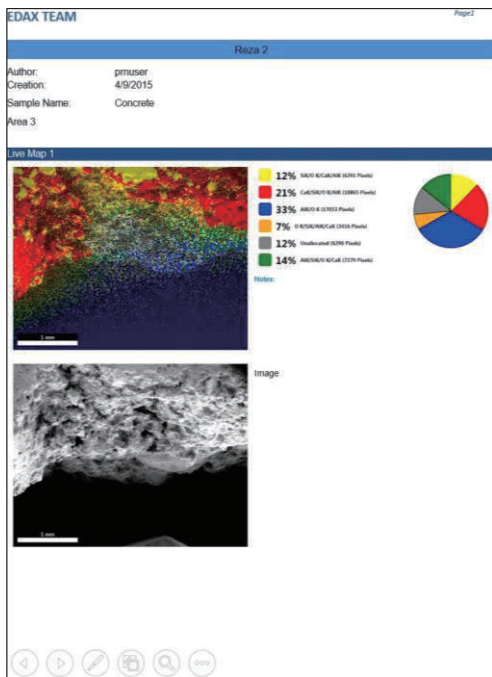


Figure 85: (left) Overview of elemental map for Area 3 - bottom third of substrate. Figure 86: (right) Individual maps of iron (Fe) for each pass.

Instrumental Analysis - Conclusion

In this first phase of instrumental analysis, a characterization of the concrete substrate was achieved and it was discovered that the observation of the depth of penetration of acid stains is difficult to ascertain. The color created by acid staining is the result of a chemical reaction between the soluble metallic salts and the calcium hydroxide in the concrete. It is integral to the concrete, that is, it cannot be separated from the substrate once the reaction has taken place. Therefore, if it is bound up with the substrate it may not appear as either a distinct layer or a concentrated band of elements. Further examination is needed to confirm whether this is the case, but having a preliminary knowledge of the composition, application, and behavior of acid stains is key to the design of a conservation program and to the selection of future coatings.

Conclusion

"The honest expression of concrete forms the crux of the problem in terms of authenticity, because the surface expresses not only the conceptual and structural intention but also the detail"

-Hubert Jan Henket¹⁷⁶

"Neither architects nor managers last forever, but what they leave behind them lasts a long time"

-Gilbert Stanley Underwood¹⁷⁷

Developing a conservation program for Jackson Lake Lodge requires consideration of all of the elements discussed herein: the importance of its location to John D. Rockefeller, Jr., without whose deep interest (and pockets) the development of a new tourist site would not have been possible; the influence of its design on Mission 66, one of the most ambitious initiatives to be implemented in the National Park Service; and the significance of the culminating work of Gilbert Stanley Underwood's career and his creative use of a type of concrete finish treatment. An understanding of how the development, construction, and use of the Lodge evolved over time is key to preparing a guide for how it will evolve in the future. Its continual operation as a hotel for the past 60 years has resulted in fundamentally few changes to the overall plan and organization of the hotel complex and the function of its major public spaces. Still, certain character-defining features, such as the Shadowood, are potentially jeopardized as the needs and requirements of visitors and staff continues to

¹⁷⁶ Henket, Hubert Jan, Opening Remarks at "The Fair Face of Concrete: Conservation and Repair of Exposed Concrete", *Proceedings International DOCOMOMO Seminar* (Eindhoven: Eindhoven University of Technology, 1997), 11.

¹⁷⁷ Gilbert Stanley Underwood to Raymond Lillie, May 11, 1954, Folder 166, Box 14, Jackson Lake Lodge: Underwood Correspondence, 1954, Record group Jackson Lake Lodge, Grand Teton Lodge Company, Rockefeller Archive Center.

change and as the building ages. This first stage of analysis outlines recommendations for the treatment of the Shadowood and considers future re-coloring as well as the management of repairs.

Another coloring campaign for Jackson Lake Lodge is expected to take place within the next few years. This will present several challenges, including the sensitive removal of the current finish, identifying goals for the resulting aesthetic, and selecting a contractor with experience in staining vertical surfaces. It is not recommended that the method of surface preparation used by the staining contractor in 2000 be repeated. While thorough, much of the original finish was lost and although there was no intention to try to retain it, there is a possibility that an attempt to return to a similar finish will be more difficult as a result of this preparation. Washing with a mild soap and water would be sufficient to remove dirt particles. Abrasive cleaning or coating removal could be used, providing that tests are performed on mock-ups prior to use on the entire building to ensure that the surface texture is not greatly affected, as this is a significant element of the Shadowood. Other alternative methods of finish removal, such as dry ice or steam, could be used but more research is needed before any definite recommendations can be made.

The question of coloration is paramount, and the decision should be made, ideally, by a group of representatives from the National Park Service, Grand Teton Lodge Company, the contracting company, and a professional conservation firm. A recreation of the original finish is probably not feasible, nor would it necessarily be desirable. The original application process was possible due to the fact that the Lodge had not yet opened to the public. Underwood was able to direct the process himself and scaffolding was already in use onsite as part of the construction process. Painting three separate layers of acid stain onto the

surface is time consuming but it also could require a skill-set that most contemporary staining contractors do not have, since acid stains are frequently sprayed onto concrete surfaces, not brushed, as in the original application. Tests should be made of different application procedures to determine whether a combination of brushing and spraying could be used to achieve the desired effect. Any procedure considered in the next coloring campaign must take into consideration the short time frame available for work on the exterior of the Lodge. This is limited primarily to the spring and summer, which is concurrent with the operating season. The impact of scaffolding and work on visitor-ship and operations must be considered, as these will directly affect both the cost of the finishing and the amount of revenue that can be expected from a potential disruption of services.

In addition to logistical challenges, the aesthetic appearance of the Shadowood must be considered. As mentioned, a return to the original finish appearance could be technically challenging but replication should not be the focus for the next campaign. The exterior has already been altered, so the use of the current color would be acceptable but an attempt to find a middle ground between the original colors and the current color could help maintain the design intention of the Shadowood. Whatever coating is used, it will have a lifecycle of approximately ten to twenty years, so the next color should be selected with its care and maintenance, and eventual replacement, in mind. Although the concrete is currently performing fairly well, there may be a time when this is not the case. There are already several situations that have necessitated overpainting and these areas are becoming more and more incongruous with the surrounding wall color. The next wall color should be selected with the need for these small repairs in mind: extra supplies should be purchased and kept on hand so that color-matching ceases to be an issue. This will not only maintain a uniform appearance, but will reduce the number of different coatings used as staff and

supplies change over the years. The goal should be to make maintaining the Shadowood as straightforward as possible, and providing resources for staff so that they can make informed decisions about repairs.

Maintaining and preserving the Shadowood is a significant aspect of the conservation program for Jackson Lake Lodge. While more research is recommended for providing appropriate future treatment methods, much more is now understood about its construction, coloration, and place within the context of other decorative concrete surface finishes.

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Appendix A: Glossary

Laitance – an accumulation of fine particles on the surface of fresh concrete due to an upward movement of water (as when excessive mixing water is used).¹⁷⁸

Energy Dispersive Spectroscopy (EDS) – the x-ray fluorescence feature of a Scanning Electron Microscope. Performs essentially the same function as XRF, but with the added capability of isolating a point, line, or area and producing an elemental map of the selected area.

Optical Microscopy – observation of a sample under a light microscope to identify layers, composition, minerals, and to infer certain properties of the sample.

X-Ray Fluorescence Spectrometry (XRF) – “an elemental analysis technique... based on the principle that individual atoms, when excited by an external energy source, emit X-ray photons of a characteristic energy or wavelength. By counting the number of photons of each energy emitted from a sample, the elements present may be identified and quantitated”.¹⁷⁹

¹⁷⁸ Definition of laitance, Merriam-Webster Dictionary website, <http://www.merriam-webster.com/dictionary/laitance>.

¹⁷⁹ James M. Guthrie and Jeffrey R. Ferguson, University of Missouri Research Reactor, “Overview of X-Ray Fluorescence”, *Archaeometry Laboratory* website, http://archaeometry.missouri.edu/xrf_overview.html.

Appendix B: Kemiko Stone Tone Acid Stain Data Sheets

Kemiko National Distributor
Kemiko Concrete Products, Inc
P O Box 1109
Leonard, TX 75452
Phone Number: (903) 587-3708
Fax Number: (903) 587-9038
Emergency Response: Infotrac (800)-535-5053

Material Safety Data Sheet

Print date: 06/09/2006

Version: 1

Revision date: 06/09/2006

1. COMPANY AND PRODUCT IDENTIFICATION

Product code: 37N-1
Product name: KEMIKO ACID STAIN MALAY TAN 37N-1

Supplier:
Epmar Corporation
13210 E. Barton Circle
Santa Fe Springs, CA 90605-3254
Phone: 562-946-8781
FAX: 562-944-9958
E-MAIL: info@epmarcorp.com
E-MAIL: she@quakerchem.com
(For Health and Safety Questions)

Emergency telephone number:
* 24 HOUR TRANSPORTATION:
**CHEMTREC: 1-800-424-9300
703-527-3887 (Call collect outside of US)
* 24 HOUR EMERGENCY HEALTH & SAFETY:
**QUAKER CHEMICAL CORPORATION: (800) 523-7010
(Within US only)
Outside of US call (703) 527-3887

2. COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENTS

Components	CAS No.	Weight %	OSHA Ceiling Limits	OSHA TWA (final):	ACGIH Ceiling Limits	ACGIH Exposure Limits:	Vendor Exposure Limits:
Ferrous chloride	7758-94-3	10 - 15%		None		1 mg/m ³	
Hydrochloric acid	7647-01-0	5 - 10%	5ppm 7mg/m ³	None	2ppm	None	

3. HAZARDS IDENTIFICATION

Emergency Overview

Risk of serious damage to eyes
The product causes burns of eyes, skin and mucous membranes.
Irritating to respiratory system.
Harmful by inhalation, in contact with skin and if swallowed.

Signal word: DANGER
Principle routes of exposure: Eyes, Skin, Inhalation
Eye contact: Corrosive to the eyes and may cause severe damage including blindness.
Skin contact: Contact causes severe skin irritation and possible burns.

SDS code: 37N-1

Product name: KEMIKO ACID STAIN MALAY TAN
37N-1

Page 1 of 8

Inhalation:	Irritating to respiratory system. Inhalation of high vapor concentrations may cause burns to the respiratory tract which can result in shortness of breath, wheezing, choking, chest pain, and impairment of lung function.
Ingestion:	Ingestion may cause nausea, vomiting, sore throat, stomach-ache and eventually lead to a perforation of the intestine. Liver and kidney injuries may occur. Large exposures may be fatal. Risk of product entering the lungs on vomiting after ingestion.
Physico-chemical properties:	No hazards resulting from material as supplied.

4. FIRST AID MEASURES

General advice:	Take off contaminated clothing and shoes immediately. Rinse immediately with plenty of water and seek medical advice.
Eye contact:	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Call a physician immediately.
Skin contact:	Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing before re-use. Discard contaminated shoes. Consult a physician.
Ingestion:	If swallowed, seek medical advice immediately and show this container or label. Do not induce vomiting. If victim is conscious, give water. Never give anything by mouth to an unconscious person.
Inhalation:	Move to fresh air in case of accidental inhalation of vapors. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Consult a physician.
Notes to physician:	Treat symptomatically.
Medical condition aggravated by exposure:	Dermatitis and asthma.

5. FIRE-FIGHTING MEASURES

Flash point (°C): NA	Flash point (°F): NA	Flash Point Method: Not applicable
Flammable limits in air - upper (%): Not determined	Flammable limits in air - lower (%): Not determined	
Suitable extinguishing media:	Use dry chemical, CO ₂ , water spray or 'alcohol' foam.	
Unusual hazards:	Gives off hydrogen by reaction with metals. In the event of fire the following can be released: hydrogen chloride gas.	
Special protective equipment for fire-fighters:	As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.	
Specific methods:	Water mist may be used to cool closed containers.	

6. ACCIDENTAL RELEASE MEASURES

Personal precautions:	Ensure adequate ventilation. Use personal protective equipment.
------------------------------	---

Environmental precautions: Do not flush into surface water or sanitary sewer system.

Methods for cleaning up: Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).

7. HANDLING AND STORAGE

Handling

Technical measures/precautions: Provide sufficient air exchange and/or exhaust in work rooms.

Safe handling advice: Wear personal protective equipment. Avoid contact with skin and eyes. Do not breathe vapors or spray mist. In case of insufficient ventilation, wear suitable respiratory equipment. Keep container tightly closed. Wash thoroughly after handling. Remove and wash contaminated clothing before re-use.

Storage

Technical measures/storage conditions: DO NOT FREEZE.. Store in original container. Keep containers tightly closed in a dry, cool and well-ventilated place.. Keep away from direct sunlight.

Incompatible products: See Section 10, Materials to avoid.

Safe storage temperature: 40-100 ° F

Shelf life: 12 months

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Components	ACGIH Ceiling Limits	ACGIH Exposure Limits:	OSHA Ceiling Limits	OSHA TWA (final):	NIOSH - Pocket Guide - TWAs:	Vendor Exposure Limits:
Ferrous chloride		1 mg/m ³		None	1mg/m ³ TWA	None
Hydrochloric acid	2ppm	None	5ppm 7mg/m ³	None	5ppmCeiling 7mg/m ³ Ceilin g	None

Engineering measures: Ensure adequate ventilation.

Personal Protective Equipment

General: Eye Wash and Safety Shower

Respiratory protection: If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, a NIOSH/MSHA certified respirator with organic vapor/HEPA filters should be worn.

Hand protection: Neoprene gloves

Skin and body protection: Chemical resistant apron, Long sleeved clothing

Eye protection: Goggles. Face-shield

Hygiene measures: Avoid contact with skin, eyes and clothing.



9. PHYSICAL AND CHEMICAL PROPERTIES:

Physical state:	Liquid
Color:	Dark yellow green
Odour:	Strong, Pungent
Boiling point/boiling range (°C):	~100
Boiling point/range (°F):	~212
Vapour pressure:	Not determined
Vapour density:	Not determined
VOC Content Product	Not determined
Solubility:	Soluble
Evaporation rate:	Not determined
pH:	<1
Flash point (°C):	NA
Flash point (°F):	NA
Decomposition temperature:	Not determined
Auto-ignition temperature:	Not determined
Density @ 15.5 ° C (g/cc) :	1.13
Bulk density @ 60 ° F (lb/gal):	9.43
Partition coefficient	Not determined
(n-octanol/water, log Pow):	
Explosive properties:	
- upper limit:	No data available
- lower limit:	No data available

10. STABILITY AND REACTIVITY

Stability:

Stable under recommended storage conditions.

Conditions to avoid:

Heat, flames and sparks.

Materials to avoid:

Alkali metals, Strong bases, Potassium, sodium, ethylene oxide, Gives off hydrogen by reaction with metals.

Hazardous decomposition products:

HCl, Cl₂, iron oxides

Polymerization:

Not applicable

11. TOXICOLOGICAL INFORMATION

No toxicological information is available on the product. Data obtained on components are summarized below.

Components	NTP:	IARC:	OSHA - Select Carcinogens	NIOSH - Selected LD50s and LC50s
Ferrous chloride	This product does not contain any material shown to be a carcinogen by the National Toxicology Program (NTP).	This product does not contain any material shown to be a carcinogen by the International Agency for Research on Cancer (IARC).	This product does not contain any material shown to be a carcinogen by OSHA.	450mg/kgOral LD50Rat 984mg/kgOral LD50Rat
Hydrochloric acid	This product does not contain any material shown to be a carcinogen by the National Toxicology Program (NTP).	This product does not contain any material shown to be a carcinogen by the International Agency for Research on Cancer (IARC).	This product does not contain any material shown to be a carcinogen by OSHA.	3124ppmInhalation LC50Rat 700mg/kgOral LD50Rat 5010mg/kgDermal LD50Rabbit

12. ECOLOGICAL INFORMATION

Persistence and degradability:	No information available
Mobility:	No data available
Bioaccumulation:	No data available
Ecotoxicity effects:	No data available
Aquatic toxicity:	Not Determined
<i>Ferrous chloride</i>	
Ecotoxicity - Fish Species Data	LC50 (Morone saxatilis - 96h) = 13.6 mg/L LC50 (Morone saxatilis - 96h) = 8 mg/L
<i>Hydrochloric acid</i>	
Ecotoxicity - Fish Species Data	LC50 (Gambusia affinis - 96h) = 282 mg/L LC50 (Lepomis macrochirus - 48h) = 3.6 mg/L

13. DISPOSAL CONSIDERATIONS

Waste from residues/unused products:	Waste disposal must be in accordance with appropriate Federal, State, and local regulations. This product, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority.
Contaminated packaging:	Do not re-use empty containers
Methods for cleaning up:	Take up mechanically and collect in suitable container for disposal.

14. TRANSPORT INFORMATION

U. S. DEPARTMENT OF TRANSPORTATION:

UN/NA ID Number:	UN3264
Proper shipping name:	Corrosive liquid, acidic, inorganic, n.o.s.(hydrochloric acid, ferrous chloride)
Hazard Class	8
Packing group:	II

RQ: Not applicable for packages of 5 gallons or less
Emergency Response Guide Number: 154

TDG (CANADA):

UN nr: UN3264
Proper shipping name: Corrosive liquid, acidic, inorganic, n.o.s.(hydrochloric acid, ferrous chloride)
TDG Hazard Classification: 8
Packing group: II

IMDG/IMO:

UN nr: UN3264
Proper shipping name: Corrosive liquid, acidic, inorganic, n.o.s.(hydrochloric acid, ferrous chloride)
Class: 8
Packing group: II
EMS: F-A, S-B
Limited quantity: 1 L

IATA/ICAO:

UN nr: UN3264
Proper shipping name: Corrosive liquid, acidic, inorganic, n.o.s.(hydrochloric acid, ferrous chloride)
Hazard Class: 8
Packing group: II
Maximum quantity for cargo only: 60 L
Maximum quantity for passenger: 5L
Limited quantity: 0.5 L

15. REGULATORY INFORMATION

CLASSIFICATION AND LABELING

OSHA Hazard Communication Standard: This product is considered to be hazardous under the OSHA Hazard Communication Standard.

Canada - WHMIS Classification Information: This product has been classified according to the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

Product Classification: Class E - Corrosive Material
Class D1- Poisonous and Infectious Material: Immediate and serious toxic effects

Product Classification
Graphic(s):



Component Classification
Data:

Ferrous chloride - 7758-94-3

WHMIS hazard class: Listed
E
E

Hydrochloric acid - 7647-01-0

WHMIS hazard class: Listed
A, D1A, E; E (including 0.02 N, 0.05 N, 0.2 N, 0.333 N, 0.5 N); D1B, E (including 10%, 28%, 2 N); D1A, E (including 31.45%, 32%)

Canadian National Pollution
Inventory Data:

Hydrochloric acid - 7647-01-0

Canada - NPRI Listed

U.S. REGULATIONS:

SARA (311, 312) hazard class: This product possesses the following SARA Hazard Categories:

Immediate Health (Acute): Yes
Delayed Health (Chronic): Yes
Flammability: No
Pressure: No
Reactivity: No

Hydrochloric acid - 7647-01-0

CERCLA/SARA - Section 302 Extremely Hazardous Listed
Substances and TPQs:

Hydrochloric acid - 7647-01-0

CERCLA/SARA 313 Emission reporting Listed

RCRA Status To be disposed of as hazardous waste
characteristic:
corrosive D002

Hydrochloric acid - 7647-01-0

CAA - 1990 Hazardous Air Pollutants: Listed

STATE REGULATIONS (RTK):

California Proposition 65 Status: No components are listed

Ferrous chloride - 7758-94-3

MARTK: Listed
NJRTK: Listed
PARTK: Listed

Hydrochloric acid - 7647-01-0

MARTK:	Listed
NJRTK:	Listed
PARTK:	Listed

INVENTORY STATUS:

United States TSCA - Sect. 8(b) Inventory:	This product complies with TSCA
Canada DSL Inventory List -	This product complies with DSL
EC EINECS/ELINCS/NLP list:	This product complies with EINECS

16. OTHER INFORMATION

Sources of key data used to compile the data sheet: Material safety data sheets of the ingredients.

Prepared by: Quaker Chemical Corporation -Safety, Health and Environmental Affairs Group - US

Reason for revision: This data sheet contains changes from the previous version in section(s) 14

HMIS classification:

NFPA rating:

Health:
3*

Health:
3

Flammability:
0

Flammability:
0

Reactivity:
1

Reactivity:
1

Personal Protection:
H

Special:
NA

* Indicates possible chronic health effect

Personal protection recommendations should be reviewed by purchasers. Workplace conditions are important factors in specifying adequate protection.

Disclaimer

This product's safety information is provided to assist our customers in assessing compliance with safety/health/environmental regulations. The information contained herein is based on data available to us and is believed to be accurate. However, no warranty of merchantability, fitness for any use, or any other warranty is expressed or implied regarding the accuracy of this data, the results to be obtained from the use thereof, or the hazards connected with the use of the product. Since the use of this product is within the exclusive control of the user, it is the user's obligation to determine the conditions for safe use of the product. Such conditions should comply with all regulations concerning the product. EPMAR Corporation ("EPMAR") assumes no liability for any injury or damage, direct or consequential, resulting from the use of this product unless such injury or damage is attributable to the gross negligence of EPMAR.

End of Safety Data Sheet

SDS code: 37N-1

Product name: KEMIKO ACID STAIN MALAY TAN
37N-1

Page 8 of 8

Selected Pages from MSDS for Kemiko Stone Tone Cola and Black

Kemiko National Distributor
 Kemiko Concrete Products, inc
 P O Box 1109
 Leonard, TX 75452
 Phone Number: (903) 587-3708
 Fax Number: (903) 587-9038
 Emergency Response: Infotrac (800)-535-5053

Material Safety Data Sheet

Print date: 06/09/2006

Version: 1

Revision date: 06/09/2006

1. COMPANY AND PRODUCT IDENTIFICATION

Product code: 37R-3
Product name: KEMIKO ACID STAIN COLA 37R-3

Supplier:
 Epmar Corporation
 13210 E. Barton Circle
 Santa Fe Springs, CA 90605-3254
 Phone: 562-946-8781
 FAX: 562-944-9958
 E-MAIL: info@epmarcorp.com
 E-MAIL: she@quakerchem.com
 (For Health and Safety Questions)

Emergency telephone number:
 * 24 HOUR TRANSPORTATION:
 **CHEMTREC: 1-800-424-9300
 703-527-3887 (Call collect outside of US)
 * 24 HOUR EMERGENCY HEALTH & SAFETY:
 **QUAKER CHEMICAL CORPORATION: (800) 523-7010(Within US only)
 Outside of US call (703) 527-3887

2. COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENTS

Components	CAS No.	Weight %	OSHA Ceiling Limits	OSHA TWA (final):	ACGIH Ceiling Limits	ACGIH Exposure Limits:	Vendor Exposure Limits:
Ferrous chloride	7758-94-3	15 - 20%		None		1 mg/m ³	
Hydrochloric acid	7647-01-0	5 - 10%	5ppm 7mg/m ³	None	2ppm	None	
Chromic chloride, basic	50925-66-1	1 - 5%		None		None	

3. HAZARDS IDENTIFICATION

Emergency Overview

Risk of serious damage to eyes
 The product causes burns of eyes, skin and mucous membranes.
 Irritating to respiratory system.
 Harmful by inhalation, in contact with skin and if swallowed.

Signal word: DANGER
Principle routes of exposure: Eyes, Skin, Inhalation
Eye contact: Corrosive to the eyes and may cause severe damage including blindness.
Skin contact: Contact causes severe skin irritation and possible burns.

SDS code: 37R-3

Product name: KEMIKO ACID STAIN COLA 37R-3

Page 1 of 9

Methods for cleaning up: Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).

7. HANDLING AND STORAGE

Handling

Technical measures/precautions: Provide sufficient air exchange and/or exhaust in work rooms.

Safe handling advice: Wear personal protective equipment. Avoid contact with skin and eyes. Do not breathe vapors or spray mist. In case of insufficient ventilation, wear suitable respiratory equipment. Keep container tightly closed. Wash thoroughly after handling. Remove and wash contaminated clothing before re-use

Storage

Technical measures/storage conditions: DO NOT FREEZE.. Store in original container. Keep containers tightly closed in a dry, cool and well-ventilated place.. Keep away from direct sunlight.

Incompatible products: See Section 10, Materials to avoid.

Safe storage temperature: 40-100 ° F

Shelf life: 12 months

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Components	ACGIH Ceiling Limits	ACGIH Exposure Limits:	OSHA Ceiling Limits	OSHA TWA (final):	NIOSH - Pocket Guide - TWAs:	Vendor Exposure Limits:
Ferrous chloride		1 mg/m ³		None	1mg/m ³ TWA	None
Hydrochloric acid	2ppm	None	5ppm 7mg/m ³	None	5ppmCeiling 7mg/m ³ Ceilin g	None
Chromic chloride, basic		None		None	None	None

Engineering measures: Ensure adequate ventilation.

Personal Protective Equipment

General: Eye Wash and Safety Shower

Respiratory protection: If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, a NIOSH/MSHA certified respirator with organic vapor/HEPA filters should be worn.

Hand protection: Neoprene gloves

Skin and body protection: Chemical resistant apron, Long sleeved clothing

Eye protection: Goggles. Face-shield

Hygiene measures: Avoid contact with skin, eyes and clothing.



9. PHYSICAL AND CHEMICAL PROPERTIES:

Physical state:	Liquid
Color:	dark green
Odour:	Strong, Pungent
Boiling point/boiling range (°C):	~100
Boiling point/range (°F):	~212
Vapour pressure:	Not determined
Vapour density:	Not determined
VOC Content Product	Not determined
Solubility:	Soluble
Evaporation rate:	Not determined
pH:	<1
Flash point (°C):	NA
Flash point (°F):	NA
Decomposition temperature:	Not determined
Auto-ignition temperature:	Not determined
Density @ 15.5 °C (g/cc) :	1.22
Bulk density @ 60 °F (lb/gal):	10.18
Partition coefficient (n-octanol/water, log Pow):	Not determined
Explosive properties:	
- upper limit:	No data available
- lower limit:	No data available

10. STABILITY AND REACTIVITY

Stability:

Stable under recommended storage conditions.

Conditions to avoid:

Heat, flames and sparks.

Materials to avoid:

Alkali metals, Strong bases, Potassium, sodium, ethylene oxide, Gives off hydrogen by reaction with metals.

Hazardous decomposition products:

HCl, Cl₂, iron oxides

Polymerization:

Not applicable

11. TOXICOLOGICAL INFORMATION

No toxicological information is available on the product. Data obtained on components are summarized below.

...
Overexposure to chromic chloride may produce the following chronic effects: May cause liver and kidney damage. Animal studies have reported that fetal effects/abnormalities may occur when maternal toxicity is seen. Effects may be delayed. Laboratory experiments have resulted in mutagenic effects.

Components	NTP:	IARC:	OSHA - Select Carcinogens	NIOSH - Selected LD50s and LC50s
Ferrous chloride	This product does not contain any material shown to be a carcinogen by the National Toxicology Program (NTP).	This product does not contain any material shown to be a carcinogen by the International Agency for Research on Cancer (IARC).	This product does not contain any material shown to be a carcinogen by OSHA.	450mg/kgOral LD50Rat 984mg/kgOral LD50Rat
Hydrochloric acid	This product does not contain any material shown to be a carcinogen by the National Toxicology Program (NTP).	This product does not contain any material shown to be a carcinogen by the International Agency for Research on Cancer (IARC).	This product does not contain any material shown to be a carcinogen by OSHA.	3124ppmInhalation LC50Rat 700mg/kgOral LD50Rat 5010mg/kgDermal LD50Rabbit
Chromic chloride, basic	This product does not contain any material shown to be a carcinogen by the National Toxicology Program (NTP).	This product does not contain any material shown to be a carcinogen by the International Agency for Research on Cancer (IARC).	This product does not contain any material shown to be a carcinogen by OSHA.	

12. ECOLOGICAL INFORMATION

Persistence and degradability: No information available

Mobility: No data available

Bioaccumulation: No data available

Ecotoxicity effects: No data available

Aquatic toxicity: Not Determined

Ferrous chloride

Ecotoxicity - Fish Species Data LC50 (Morone saxatilis - 96h) = 13.6 mg/L
LC50 (Morone saxatilis - 96h) = 8 mg/L

Hydrochloric acid

Ecotoxicity - Fish Species Data LC50 (Gambusia affinis - 96h) = 282 mg/L
LC50 (Lepomis macrochirus - 48h) = 3.6 mg/L

13. DISPOSAL CONSIDERATIONS

Waste from residues/unused products: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. This product, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority.

Contaminated packaging: Do not re-use empty containers

Kemiko National Distributor
Kemiko Concrete Products, inc
P O Box 1109
Leonard, TX 75452
Phone Number: (903) 587-3708
Fax Number: (903) 587-9038
Emergency Response: Infotrac (800)-535-5053
Print date: 12/14/2004

Material Safety Data Sheet

Version: 2

Revision date: 12/14/2004

1. COMPANY AND PRODUCT IDENTIFICATION

Product code: 37B-1
Product name: KEMIKO ACID STAIN BLACK 37B-1

Supplier:
Epmar Corporation
13210 E. Barton Circle
Santa Fe Springs, CA 90605-3254
Phone: 562-946-8781
FAX: 562-944-9958
E-MAIL: info@epmarcorp.com
E-MAIL: she@quakerchem.com
(For Health and Safety Questions)

Emergency telephone number:
* 24 HOUR TRANSPORTATION:
**CHEMTREC: 1-800-424-9300
703-527-3887 (Call collect outside of US)
* 24 HOUR EMERGENCY HEALTH & SAFETY:
**QUAKER CHEMICAL CORPORATION: (800) 523-7010
(Within US only)
Outside of US call (703) 527-3887

2. COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENTS

Components	Weight %	CAS No.	OSHA Ceiling Limits	OSHA TWA (final):	ACGIH Ceiling Limits	ACGIH Exposure Limits:
Manganese chloride	5 - 10%	7773-01-5	5mg/m ³	None		0.2 mg/m ³ 0.2 mg/m ³
Sodium dichromate	1 - 5%	10588-01-9	0.1mg/m ³	1mg/m ³		0.01 mg/m ³ 0.05 mg/m ³ 0.5 mg/m ³
Hydrochloric acid	1 - 5%	7647-01-0	5ppm 7mg/m ³	None	2ppm	None

3. HAZARDS IDENTIFICATION

Emergency Overview

Risk of serious damage to eyes
The product causes burns of eyes, skin and mucous membranes.
Harmful in contact with skin.
Very toxic by inhalation.
Toxic if swallowed.

Principle routes of exposure: Eyes, Skin, Inhalation

Signal word: DANGER

Eye contact: Severe eye irritation. Corrosive to the eyes and may cause severe damage including blindness.

Skin contact: Causes skin burns. May cause severe, irreversible damage to skin. May cause allergic skin reaction. Components of the product may be absorbed into the body through the skin. Kidney injury may occur. Large exposures may be fatal.

SDS code: 37B-1

Product name: KEMIKO ACID STAIN BLACK
37B-1

Page 1 of 10

Specific methods:

Water mist may be used to cool closed containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions:

Ensure adequate ventilation. Use personal protective equipment.

Environmental precautions:

Do not flush into surface water or sanitary sewer system.

Methods for cleaning up:

Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).

7. HANDLING AND STORAGE

Handling

Technical measures/precautions:

Provide sufficient air exchange and/or exhaust in work rooms.

Safe handling advice:

Wear personal protective equipment. Keep away from combustible material. Keep container tightly closed. Avoid contact with skin and eyes. Do not breathe vapors or spray mist. In case of insufficient ventilation, wear suitable respiratory equipment. Wash thoroughly after handling. Remove and wash contaminated clothing before re-use

Storage

Technical measures/storage conditions:

DO NOT FREEZE.. Store in original container. Keep containers tightly closed in a dry, cool and well-ventilated place.. Keep away from direct sunlight.

Incompatible products:

See Section 10, Materials to avoid.

Safe storage temperature:

40-100 ° F

Shelf life:

12 months

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Components	ACGIH Ceiling Limits	ACGIH Exposure Limits:	OSHA Ceiling Limits	OSHA TWA (final):	NIOSH - Pocket Guide - TWAs:	Vendor Exposure Limits:
Manganese chloride		0.2 mg/m ³ 0.2 mg/m ³	5mg/m ³	None	1mg/m ³ TWA 1mg/m ³ TWA 3mg/m ³ STEL 3mg/m ³ STEL	None
Sodium dichromate		0.01 mg/m ³ 0.05 mg/m ³ 0.5 mg/m ³	0.1mg/m ³	1mg/m ³	0.001mg/m ³ TWA 0.5mg/m ³ TWA	None
Hydrochloric acid	2ppm	None	5ppm 7mg/m ³	None	5ppmCeiling 7mg/m ³ Ceilin g	None

Engineering measures:

Use only in area provided with appropriate exhaust ventilation.

Personal Protective Equipment

Stability:

Stable under recommended storage conditions.

Polymerization:

Not applicable

11. TOXICOLOGICAL INFORMATION

No toxicological information is available on the product. Data obtained on components are summarized below.

Components	NTP:	IARC:	OSHA - Select Carcinogens	NIOSH - Selected LD50s and LC50s
Manganese chloride	This product does not contain any material shown to be a carcinogen by the National Toxicology Program (NTP).	This product does not contain any material shown to be a carcinogen by the International Agency for Research on Cancer (IARC).	This product does not contain any material shown to be a carcinogen by OSHA.	1031mg/kgOral LD50Mouse 250mg/kgOral LD50Rat 9g/kgOral LD50Rat
Sodium dichromate	Known Carcinogen	Monograph 49, 1990 (Evaluated as a group)	Present	50mg/kgOral LD50Rat
Hydrochloric acid	This product does not contain any material shown to be a carcinogen by the National Toxicology Program (NTP).	This product does not contain any material shown to be a carcinogen by the International Agency for Research on Cancer (IARC).	This product does not contain any material shown to be a carcinogen by OSHA.	1108ppmInhalation LC50Mouse 3124ppmInhalation LC50Rat

12. ECOLOGICAL INFORMATION

Persistence and degradability: No information available

Mobility: No data available

Bioaccumulation: No data available

Ecotoxicity effects: No data available

Aquatic toxicity: Not Determined

Sodium dichromate

Ecotoxicity - Fish Species Data

- = 200 mg/L LC50 striped catfish 96 h
- = 213 mg/L LC50 bluegill 96 h Static
- = 33.2 mg/L LC50 fathead minnow 96 h flow-through
- = 36.2 mg/L LC50 fathead minnow 96 h
- = 69 mg/L LC50 rainbow trout 96 h flow-through
- = 7.6 mg/L LC50 rainbow trout 96 h

Hydrochloric acid

Ecotoxicity - Fish Species Data = 3.6 mg/L LC50 bluegill 48 h

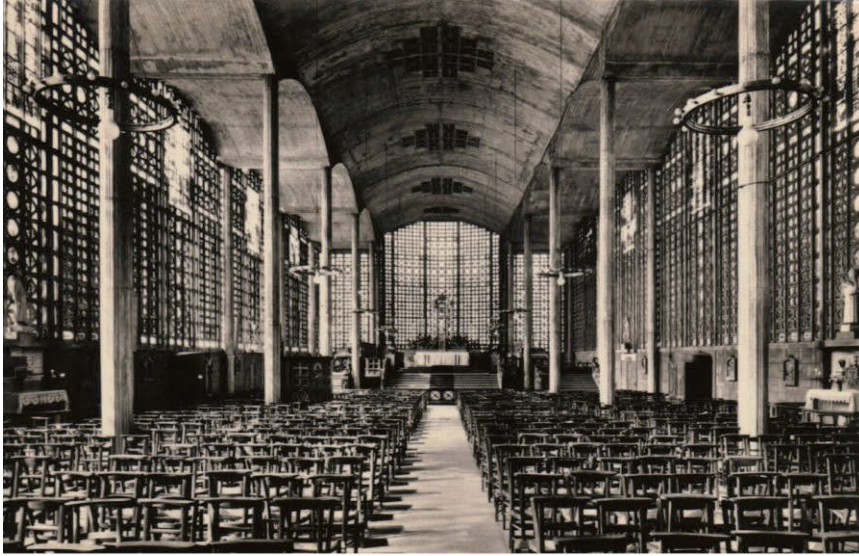
Appendix C: Supplemental Images



Appendix C, Figure 1: Frank Lloyd Wright's Unity Temple, Oak Park, IL, circa 1910. Credit: www.worldhistoryproject.org.



Appendix C, Figure 2: Detail of Le Corbusier's Unite d'habitation, Marseilles, 1946-52. Credit: downtown-creator.net (contemporary image).



Appendix C, Figure 3: Interior of Auguste Perret's Church of Notre Dame, le Raincy, 1922-23. Credit: iliaspisios.tumblr.com.



Appendix C, Figure 4: Detail of Louis Kahn's Exeter Library, Yale University, New Canaan, CT, 1965-72). Credit: www.mydstudio.com.



Appendix C, Figure 5: Detail of Paul Rudolph's Massachusetts Government Service Center, Boston, MA, 1962-71. Credit: [architectureofdoom.tumblr.com](https://www.tumblr.com/architectureofdoom).



Appendix C, Figure 6: Jackson Lake Lodge, circa 1956. Credit: Grand Teton Lodge Company.



Appendix C, Figure 7: A batch plant was constructed onsite for the production of all of the concrete for the project. Credit: Jackson Hole Historical Society.



Appendix C, Figure 8: Construction photo showing pouring a concrete floor slab. Credit: Jackson Hole Historical Society.



Appendix C, Figure 9: Original Shadowood enclosed above Blue Heron Bar. Credit: Author, 2015.



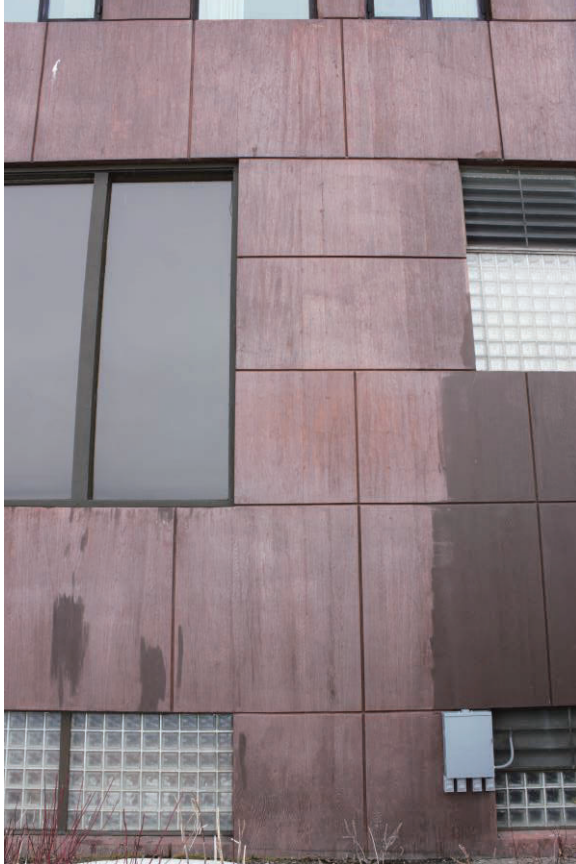
Appendix C, Figure 10: Detail of original Shadowood. Credit: Author, 2015.



Appendix C, Figure 11: Illustration of use of plywood of varying widths to create Shadowwood. Credit: Author, 2015.



Appendix C, Figure 12: Detail of sill cracks on Shadowwood panel. Credit: Author, 2015.



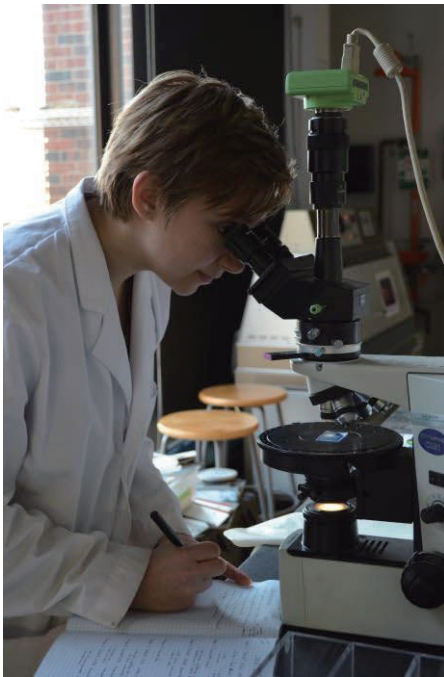
Appendix C, Figure 13: Illustration of inappropriate repair coating. Credit: Author, 2015.



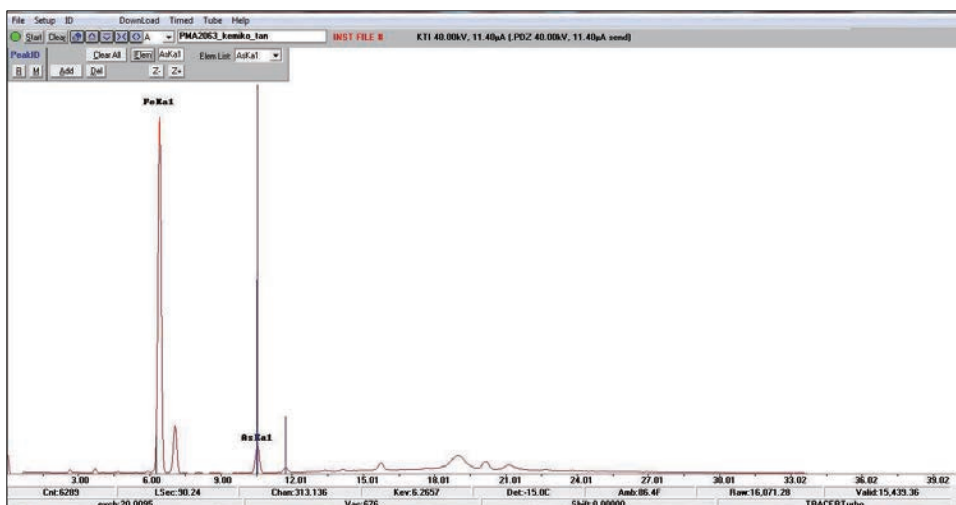
Appendix C, Figure 14: Detail of drips illustrating water-solubility of coating from 2000. Credit: Author, 2015.



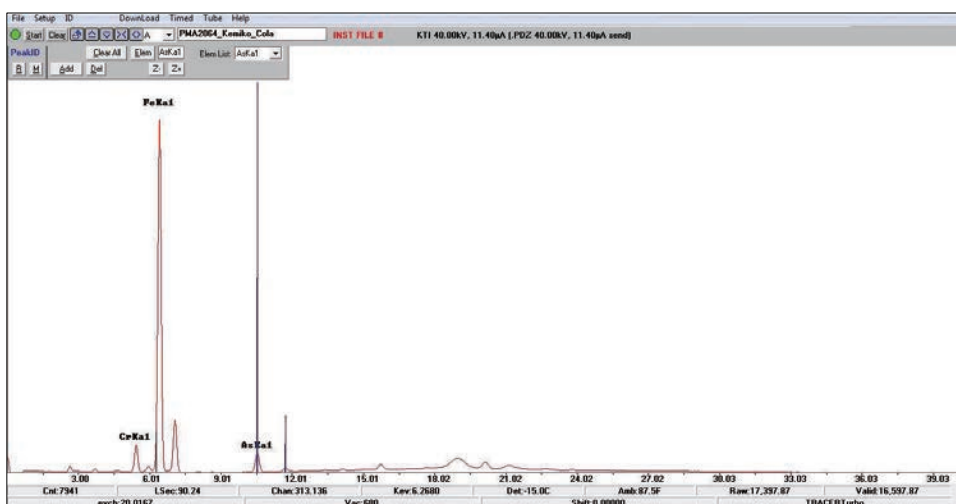
Appendix C, Figure 15: Onsite at Jackson Lake Lodge performing condition survey. Credit: N. Iyer, 2015.



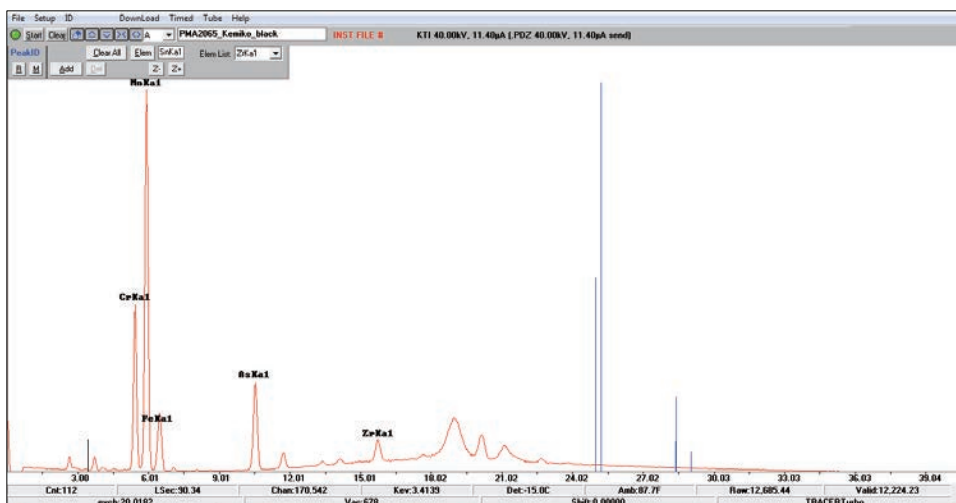
Appendix C, Figure 16: Back in the lab in Philadelphia. Credit: J. Chan, 2015.



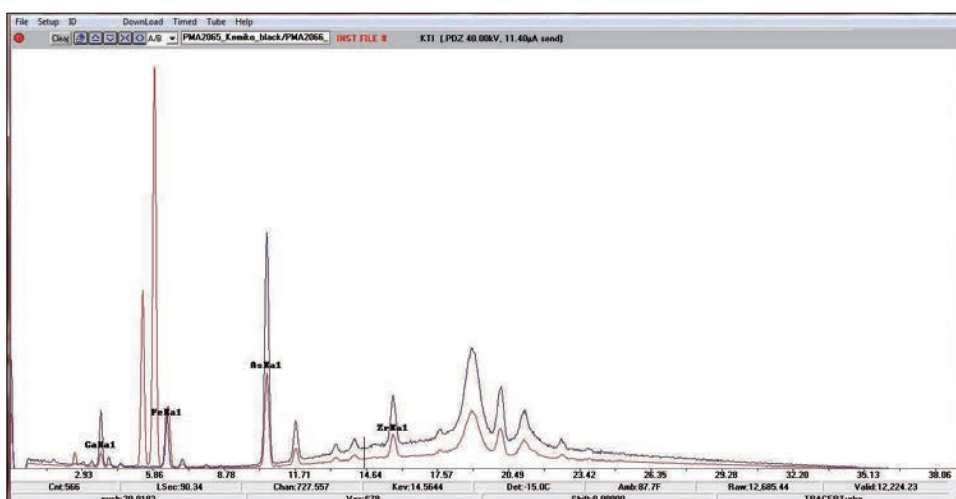
Appendix C, Figure 17: XRF Spectrum for Kemiko acid stain standard, Malay Tan.



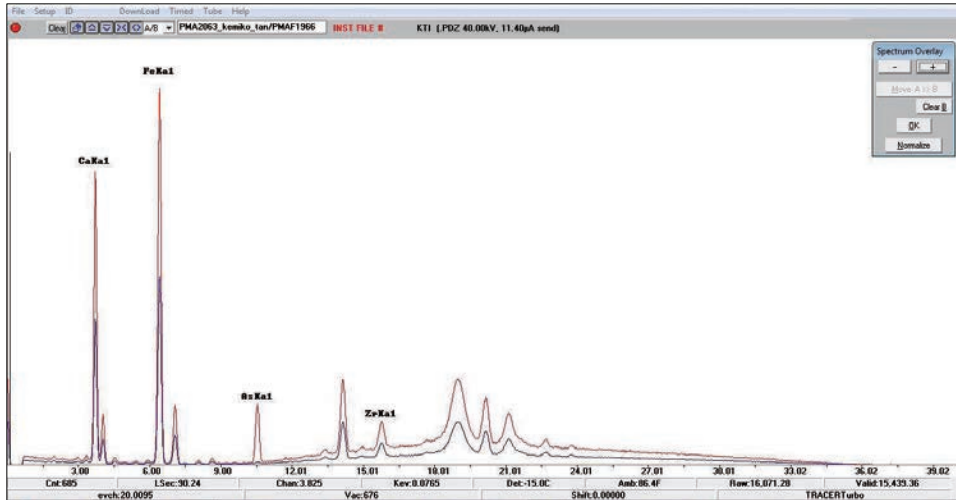
Appendix C, Figure 18: XRF Spectrum for Kemiko acid stain standard, Cola. Note presence of chromium, not typically listed as an ingredient in acid stains unless used with copper.



Appendix C, Figure 19: XRF Spectrum for Kemiko acid stain standard, Black.



Appendix C, Figure 20: Overlay of spectra for Kemiko Black and glass microscope slide, which accounts for presence of calcium, zirconium, and arsenic appearing in spectra for acid stains.



Appendix C, Figure 21: Overlay of spectra for Kemiko Malay Tan (red) and the original 1955 acid stained finish (blue). The difference between the iron (Fe) peaks suggests that exterior acid staining could be affected by weathering.



Appendix C, Figure 22: The view of Jackson Lake and the Grand Tetons from the west side of Jackson Lake Lodge. Credit: Author, 2015.

Appendix D: Jackson Lake Lodge Building Design and Construction History

Context

The construction of Jackson Lake Lodge in Grand Teton National Park, Wyoming in 1955 marked a turning point for the National Park Service both operationally and architecturally. The establishment of the National Parks in the early 20th century saw thousands of Americans leave their towns and cities to enjoy the splendor of America's natural beauty. For the first time many of these visitors would travel by automobile, although major railway lines had been drawing travelers westward for many years and continued to do so. The accommodations provided were typically built along train lines in styles that expressed architecturally the romanticism of the great outdoors. Typically, this meant borrowing the steeply roofed alpine lodge designs of Northern Europe to lend a sense of luxury and old-world nostalgia to grand hotels built primarily of wood and stone. Yellowstone National Park's Old Faithful Inn and the Ahwahnee Hotel in Yosemite National Park are two well-known examples of this style. For many, this "rustic" appearance came to define the National Park experience. However, in the years between the Great Depression and the Second World War, budget cuts and little maintenance had degraded park resources and the existing lodges were no longer adequate to support the ever greater numbers of visitors flocking to the National Parks, now exclusively by automobile.

The circumstances leading up to the initiation of a new management program for the National Parks, beginning in 1956, known as Mission 66, has been well documented in Ethan Carr's book of the same name.¹⁸⁰ Carr discusses how a turn towards modernism, and

¹⁸⁰ Ethan Carr, *Mission 66: Modernism and the National Park Dilemma*, (Amherst: University of Massachusetts Press, 2007).

in particular the International Style, came to define a new approach by the National Park Service in addressing the needs of the public while also satisfying the concerns of wildlife conservation on the human impact on the natural landscape. Jackson Lake Lodge, a modernist, International-style building, was completed one year prior to the initiation of the 10-year Mission 66 program, and ultimately set the precedent for Park architecture from that point forward. Its location within the newly-created Grand Teton National Park was intended to encourage visitors to consider the Park as a destination and not just a place to pass through on their way to Yellowstone National Park.

The Lodge complex is characterized by its motor court-style arrangement of a central lodge flanked by groups of semi-attached, smaller lodges or cottages that extend down small lanes on either side of the main parking lot. With so many visitors arriving by car, convenience was a priority in the design, so besides accommodations, the Lodge provided a full restaurant, a diner, and a convention hall, while the surrounding complex included a service station, corral and tack room, and access to boating and fishing on Jackson Lake. Originally, entertainment was limited to that which could be had in the outdoors, along with an “Old West”-themed bar and regular events such as Park Ranger lectures and square dances. No televisions were installed in any of the rooms, a rare feature that endures today. Unlike the grand, picturesque, rustic lodges of the early 20th century, Jackson Lake Lodge was intended to be more of a means to an end – the real attraction was meant to be the landscape, not the architecture.

This intention was communicated partly through the construction of the central lodge.

While the guest lodges and employee buildings were built of timber, the central lodge was

constructed of steel reinforced, cast-in-place concrete. Although Jackson Lake Lodge was not the first lodge within the National Park system to be built using reinforced concrete, as its fire-resistant qualities were a much desired feature, the material was not well-suited visually to the naturalistic references that influenced the design of the “rustic” lodges. Although Gilbert Stanley Underwood, the architect of Jackson Lake Lodge, used concrete in his design for the Ahwahnee Hotel in Yosemite National Park in 1927, it was mainly structural and exposed areas were made to look like wooden construction, thus disguising the material. Interestingly, his use of concrete at Jackson Lake Lodge was also structural, and again he rendered the exposed exterior concrete with the impression and color of wood. In this case, however, there was no hiding the fact that the building was constructed from concrete. Rather, the wood-grain finish, which Underwood called “Shadowood”, was a cast surface treatment that suggested regularized wood panel cladding in an updated reference that recalled the rustic wooden lodges of the past.

By the mid-20th century, concrete construction was becoming more cost effective and widespread than other structural systems due to improvements in cement technology and concrete mixing and delivery on site.¹⁸¹ The economic boom following World War II, as well as a severe housing shortage, promoted the application of concrete buildings and especially the clean simple lines of the avant-garde International style of the 1920s and 30s. It was not unusual, therefore, for Underwood to design Jackson Lake Lodge in a style and material that was already familiar to most visitors, as well as its full-service tourist center with its court-

¹⁸¹ Thomas Jester, Ed., *Twentieth Century Building Materials: History and Conservation* (Los Angeles: Getty Conservation Institute, 2014).

cabin arrangement, referencing a typology that was well in place thanks to the popularity of automobile travel.

Project Design

The development of the Jackson Lake Lodge tourist center was characterized by strong personalities and contract disputes. Although the construction period for Jackson Lake Lodge was short, the design and planning process took several years. Beginning with the acquisition of the lands that encompass Jackson Lake Lodge and eventually became Grand Teton National Park in the early 20th century, accommodations of one form or another were always planned for the area around Jackson Lake, although their configurations were often changed. By 1946, a temporary architect was being sought who could supervise the transition of old Jackson Lake Lodge, Moran, and Jenny Lake Lodge into suitable accommodations for larger numbers of visitors. Two architects by the names of Edward Young and Jan Van Tyen Wilking were recommended by A.E. Kendrew, the chief draftsman and resident architect of Colonial Williamsburg, and Wyoming Governor Leslie Miller, respectively. However, as plans for the development progressed, it was felt that a full-time experienced architect should be hired to design the program. It was at this point that Gilbert Stanley Underwood came into the picture. At the time of his recommendation, Underwood was Supervising Architect for the federal government but had recently completed a hotel for John D. Rockefeller, Jr. at Colonial Williamsburg. He was also well known throughout the National Park Service as having designed some of its most beloved hotels, the Ahwahnee being the most popular.

In 1950, Underwood presented a development proposal entitled “A Scheme for the Development of Public Concessions in Grand Teton National Park”¹⁸². In it, he described the very real problem of the lack of adequate public concessions throughout the National Parks that needed to support the ever increasing numbers of visitors in a way that was clean and efficient. His solution was to develop three concessions of varying capacities at Jackson Lake, Jenny Lake, and Colter Bay, with Jackson Lake Lodge providing the largest number of accommodations. Even at this early stage, Underwood’s design includes some of the most enduring features of Jackson Lake Lodge such as the use of a ground floor entrance to draw guests into a main lounge facing the dramatic Teton Range. It also outlined the need for fireproof or semi-fireproof construction in the central lodge but not for out-buildings such as the guest lodges, which were intended to be timber construction. In his proposal Underwood specifically referenced the American motor lodge, emphasizing that tourists were seeking modern conveniences, such as having their cars easily accessible from their accommodations, and that by providing these conveniences the concession at Jackson Lake Lodge would shift the focus from the Lodge to the natural environment as a source of entertainment and activity. His initial scheme was quite specific and discussed all aspects of the proposed central lodge and surrounding buildings, from utilities, to service stations and shops, to staff housing, and even to furnishings. Although there would be many changes to the interior of the lodge from this initial description to its completion, the overall design established in this proposal would remain the same.

¹⁸² Gilbert Stanley Underwood, “A Scheme for the Development of Public Concessions in Grand Teton National Park”, December 1, 1950; Folder 831, Box 90, Cultural Interest Series, Record Group 2 OMR, RFA, RAC.

The design and construction process is well documented in the correspondence between key players for the project, namely, Harold P. Fabian, who was elected Executive Vice President of the Board of the Grand Teton Lodge & Transportation Company and acted as General Manager for the project until the addition of Raymond Lillie; the contractor, Morrison-Knudsen¹⁸³, and their project manager and accountant, Paul Wise and Murray Burns; and of course, Underwood. Kenneth Chorley, manager of several operations including Colonial Williamsburg¹⁸⁴ and a close advisor of the Rockefellers, was often the recipient of these letters, particularly from Fabian, and was typically the first point of contact for anything requiring the Rockefellers' approval. Through these primary documents, a chronology of the project can be constructed

Even with the design of the building envelope of the central lodge clearly defined in Underwood's "Scheme" of 1950, many other aspects remained vague until quite late in the construction process. Initially, the plan was to eliminate Moran as a stop for tourists and combine the remaining buildings with those at old Jackson Lake Lodge. This was proposed by Underwood in 1950 as "Stage 1".¹⁸⁵ However, by 1952 the decision was made to abandon Stage 1 and implement Stage 2, which was to build an entirely new tourist center at Jackson Lake Lodge. Harold Fabian's influence on this plan was quite strong from the outset – even before the decision to build a new Jackson Lake Lodge was made, he was in frequent communication with Underwood and Kenneth Chorley about what should be

¹⁸³ Morrison-Knudsen was one of the top contracting companies in the country, known primarily for their work on industrial projects. Some of their most significant projects include Three Mile Falls Dam in Oregon, the Hoover Dam, and Cam Ranh Bay naval base in Vietnam. "About MK", Morrison-Knudsen Corporation website, www.morrison-knudsen.com/aboutMK.html.

¹⁸⁴ Elizabeth Flint, *"Beneath the Jagged Tetons": Gilbert Stanley Underwood and the Architecture of Jackson Lake Lodge*, Thesis, (University of Virginia, 2009), 12.

¹⁸⁵ Gilbert Stanley Underwood, "A Scheme for the Development of Public Concessions in Grand Teton National Park", December 1, 1950; Folder 831, Box 90, Cultural Interest Series, Record Group 2 OMR, RFA, RAC.

included in the development. In a letter to Chorley in August of 1952, Fabian claimed he was “advocating nothing...but, having studied the situation in detail...I feel I should not simply sit here and be silent when some of my thoughts on the subject may or may not be of value to you”¹⁸⁶. He went on to identify some of the difficulties of moving ahead with the plans, including getting the Park Service to fulfill their promise of some 15 years¹⁸⁷ to install proper water, sewer, utilities, roads and garbage disposal systems in Grand Teton and Yellowstone National Park. There was also the challenge of supporting the tourist seasons simultaneously with construction of the new lodge. Letters to Underwood from Fabian at this time included many items for consideration: one letter of July, 1952 contained at least twelve “suggestions” describing the need for things such as a vault, service station, post office, and enough parking for upwards of twenty tour busses. Fabian even included a rough sketch of how he thought the Lodge could be laid out, prioritizing the view towards the Tetons¹⁸⁸. Still, despite the somewhat overbearing nature of his letters, correspondence between Fabian and Underwood was friendly, at least in the beginning, with Underwood welcoming Fabian’s suggestions and comments and making references to how much he and his wife had enjoyed spending time with Fabian and Fabian’s wife, Josephine. Much care was taken on both sides to emphasize that any suggestions made were not to be taken as directives – neither one wanted to step on the others’ toes.

¹⁸⁶ Harold P. Fabian to Kenneth Chorley, August 4, 1952, Folder 163, Box 13a, Underwood Correspondence 1950-1952 series, Record Group Jackson Lake Lodge, Grand Teton Lodge Company Collection, RCA.

¹⁸⁷ Harold P. Fabian to Kenneth Chorley, August 4, 1952, Folder 163, Box 13a, Underwood Correspondence 1950-1952 series, Record Group Jackson Lake Lodge, Grand Teton Lodge Company Collection, RCA.

¹⁸⁸ Harold P. Fabian to Gilbert Stanley Underwood, August 13, 1952, Folder 163, Box 13a, Underwood Correspondence 1950-1952 series, Record Group Jackson Lake Lodge, Grand Teton Lodge Company Collection, RCA.

Underwood continued honing his designs for the site plan and lodge buildings throughout the summer of 1952. By September, he referred in his letter to Fabian to a “‘New’ Central Lodge” that boasted a fully roofed entrance, retail and bar on the first floor, a view of the Tetons through windows in the lounge, a recreation room, offices on the ground floor, an employee cafeteria, and a boiler room. Also in this letter, Underwood mentioned an interior wood treatment he had seen that would eventually become known as Shadowood: “It is a molded board laid vertically, knots (solid) freely exposed, and the whole stained a light brown to help destroy the sharp contrast of the knots with the lighter background”¹⁸⁹. However, before interior designs could be discussed further, there was the ever-present question of cost. Preliminary estimates began to run high, so Underwood suggested eliminating the second floor altogether and considering timber construction for the central lodge¹⁹⁰. He was hesitant about this decision, writing “I hate to give up a fireproof building for the Central Lodge...but the estimates are running so damned high that we must seek for every saving we can make without damaging the earnings”¹⁹¹. The projected cost at this point was about four million dollars and while Underwood was approved to complete the plans for the new lodge and guest cottages, there was a tangible sense of pressure in the correspondence to save money wherever possible.

Building Construction

¹⁸⁹ Gilbert Stanley Underwood to Harold P. Fabian, September 8, 1952, Folder 163, Box 13a, Underwood Correspondence 1950-1952 series, Record Group Jackson Lake Lodge, Grand Teton Lodge Company Collection, RCA.

¹⁹⁰ Gilbert Stanley Underwood to Harold P. Fabian, September 12, 1952, Folder 163, Box 13a, Underwood Correspondence 1950-1952 series, Record Group Jackson Lake Lodge, Grand Teton Lodge Company Collection, RCA.

¹⁹¹ Gilbert Stanley Underwood to Harold P. Fabian, September 12, 1952, Folder 163, Box 13a, Underwood Correspondence 1950-1952 series, Record Group Jackson Lake Lodge, Grand Teton Lodge Company Collection, RCA.

The year 1953 marked the start of the Jackson Lake Lodge construction in earnest. Underwood was hard at work finishing up the site plans and responding to frequent recommendations being made by Harold Fabian, who seemed to be continually inspired by the operations he observed at his winter location in the Hotel Utah in Salt Lake City. Of primary concern for Fabian was the front office and lobby space, which he anticipated would need to accommodate some 800-1000 guests. Underwood revealed his concern about these large numbers in a letter to Frank Sullivan at the Dohrmann Hotel Supply Company stating "I am trying to stop our clients from doing another deal like the Ahwahnee with a hundred rooms and public space for a thousand people. The outside guest lodges we hoped to build never materialized"¹⁹². Perhaps because of this experience, Underwood placed most of the accommodations in individual cottages flanking the central lodge, and while the large gathering spaces in the lodge could seat up to 600, this number was still a comfortable distance from the intimidating thousand Fabian originally had in mind.

From February to May, 1953, changes were proposed for the kitchen, ground floor lobby, and the maintenance shops and storage areas, with the kitchen dominating the conversation between Fabian and Underwood. Ultimately, it grew to encompass two floors, which resulted in an increase in the size of the overall building envelope. The paint shop and boiler room were moved to auxiliary buildings that were still connected to the main lodge. By April, the guest lodges, timber buildings, employees' dormitory, and recreation hall were half-finished and Underwood estimated that the plans for the central lodge were about 15% complete. The pace seems to have been intense, but Underwood remained

¹⁹² Gilbert Stanley Underwood to Frank Sullivan, February 7, 1953, Folder 165, Box 13a, Underwood Correspondence 1953 series, Record Group Jackson Lake Lodge, Grand Teton Lodge Company Collection, RCA.

optimistic, stating “It’s tough but it’s fun!”¹⁹³ However, this positive attitude was soon put to the test as the construction process encountered a few road blocks. Housing for the workmen became scarce, especially in anticipation of the upcoming tourist season, and with the arrival of a team of engineers there was even more pressure to complete the employees’ housing and recreation hall that would be used as temporary housing. An appropriation bill had to be passed before the main contract could be signed. Even the site clearing contract was on hold because Underwood’s drawings were changing so frequently that they could not be used to obtain a firm estimate.¹⁹⁴ A gentle reminder from Harold Fabian resulted in Underwood rushing the plans to the site but when they arrived it was discovered that there were many additional details on them that did not appear on the previous version. The delay in the submission of the plans was attributed to the fact that both Underwood’s chief structural engineer and his head architect had been in and out of the hospital for illness and operations. A further delay toward the end of July came in the form of the discovery of pumice in the soil during excavations, which required the installation of costly piles.

Despite these setbacks, the atmosphere around the worksite was still friendly and collaborative. The contractor, Morrison-Knudsen, was eager to take advantage of the good late summer weather and was making progress quickly; too quickly, it seemed, for Underwood to keep up with supplying plans and specifications.¹⁹⁵ This became problematic, because without completed plans and specifications, no guaranteed maximum estimate

¹⁹³ Gilbert Stanley Underwood to Kenneth Chorley, April 28, 1953, Folder 165, Box 13a, Underwood Correspondence 1953 series, Record Group Jackson Lake Lodge, Grand Teton Lodge Company Collection, RCA.

¹⁹⁴ Harold P. Fabian to Kenneth Chorley, May 20, 1953, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

¹⁹⁵ Harold P. Fabian to Kenneth Chorley, July 22, 1953, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

could be made by the contractor. Without this number, no final contract could be signed. There was great concern about whether the work called for in the drawings would exceed the budget, especially because the changes intended for the kitchen required significant structural changes.¹⁹⁶ These changes were deemed necessary enough to keep, but there were attempts to cut costs in other areas. For example, in a letter to John Green of the Williamsburg Inn, Underwood wrote, "I hope we do not decrease the quality and plan of the feeding operation. It is damned good, and I'd prefer to sacrifice elsewhere if we can"¹⁹⁷. To that end, Underwood proposed reducing the laundry capacity, eliminating refrigeration on the ground floor and replacing it with smaller freezer boxes, and eliminating all but the sun deck shelter over the entrance drive. Additionally, the windows on the ground floor were changed to aluminum, instead of the original steel. The windows in the rest of the central lodge were intended to be double-hung wooden windows. However, when the first bid was received for the aluminum windows it was more than \$100,000 – far beyond what anyone was willing to spend, despite the anticipated savings from this "no-maintenance" solution.¹⁹⁸ Even without the cost of the windows, an extra \$48,000 was added to the overall cost due to expansion of the central lodge by 11,600 square feet to accommodate the kitchen equipment and maintenance shops, an increase in the capacity of both the boiler and laundry, and the stabilization of the foundation.¹⁹⁹ This number was still within the

¹⁹⁶ Harold P. Fabian to Kenneth Chorley, August 13, 1953, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

¹⁹⁷ Gilbert Stanley Underwood to John Green, August 15, 1953, Folder 164, Box 13a, Underwood Correspondence 1953 series, Record Group Jackson Lake Lodge, Grand Teton Lodge Company Collection, RCA.

¹⁹⁸ Harold P. Fabian to Kenneth Chorley, August 27, 1953, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

¹⁹⁹ Harold P. Fabian to Kenneth Chorley, August 27, 1953, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

contractor's overall estimate of \$3,920,000 but it did not leave any room for contingency should something else go wrong or be changed significantly.

It was expected that a final contract would finally be ready by the second week in September, however, on September 9, 1953, Harold Fabian wrote to Kenneth Chorley to inform him that Underwood had been taken to the hospital after a night of severe breathing difficulties. According to Fabian, Underwood had undergone a serious operation in December of 1952 and was also struggling with diabetes. The diagnosis of September 9th was that Underwood was suffering from an "overstrained nervous system". Fabian attributed this condition to the fact that Underwood was left practically on his own to complete all of the plans and specifications for all of the changes implemented over the summer. The one draftsman who had been assisting him had to return to Washington, D.C. and a kitchen engineer had been flown in to help but there was clearly more to do than could reasonably be completed by such a small team. With the onset of winter, the decision was made to have Morrison-Knudsen complete as much work as possible using the plans and specifications available, with supplements expected from Underwood over the following weeks. Work on the exterior would be put on hold during the winter months, while Underwood would return to Washington, D.C. and take this time to complete the drawings with the help of his firm. As it was, Morrison-Knudsen's accountant Murray Burns was hesitant to have work continue without completed plans, since any further changes would result in yet more delays. An additional memorandum agreement was drafted so that the contractor would be allowed to perform this work. Construction of the entire site was expected to be complete by October 1, 1954.²⁰⁰

²⁰⁰ Harold P. Fabian to Kenneth Chorley, September 12, 1953, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

An interim agreement was signed as of October 6, 1953 and Underwood promised to have specifications for the entire project completed within two weeks of this date. He also promised to have a detailed plan for the entire project completed by December 31, 1953, at which point the final contract was to be signed.²⁰¹ George Richardson of Thermal Engineering Company was brought on to work on the mechanical and electrical drawings for the site. As of late November, 1953, he was completing “as constructed” heating plans for the central lodge. On November 24th, Underwood wrote to him that the roof of the central lodge had been completed, the windows were about to be installed, and everything was prepared for the interior work planned for the winter. Both Underwood and Fabian were very pleased with how the exterior concrete had been executed and Underwood wrote that he hoped “...all of the mechanical installation reaches the same high level...” as the work completed to date.²⁰² One month later, on December 24, 1953, Underwood submitted the finished drawings for the Jackson Lake Lodge development.

Unfortunately, they were not exactly what the contractor expected. By this time, Raymond Lillie had joined the team at Jackson Lake Lodge as general manager. In one of his first reports to Kenneth Chorley in early February, 1954 he chronicled the new challenges facing the project. The plans submitted by Underwood as of December 24th did not correlate with those from the interim agreement of October 6th. Rather, in order to complete the work as specified, much of the work that had been completed prior to October 6th would have to be

²⁰¹ Harold P. Fabian to John Duncan, October 9, 1953, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

²⁰² Gilbert Stanley Underwood to George Richardson, November 24, 1953, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

removed. Also, there were a number of additions to the plans of December 24th that had not been included on any previous plans, but these reflected the changes to heating, plumbing, ventilation, and electrical resolved at the time of the interim contract in October.²⁰³ These changes amounted to more than \$250,000 in extra costs, so more suggestions were made to reduce the new total, which was reaching \$4,200,000. These included eliminating the convention hall (or at least eliminating the stage and the projection room) and porte-cochere, using Morrison-Knudsen's heating and electrical plans, and making some minor changes to door types, hardware, and pipes.²⁰⁴

To make matters worse, Underwood continued to submit plans and specifications late and with several additions. Frustration with him was evident throughout the correspondence between Harold Fabian, Kenneth Chorley, and Ray Lillie, despite their efforts to give Underwood the benefit of the doubt. No one seems to have questioned the fact that Underwood was working very hard, but the frequent changes, delays, and rising costs prompted Lillie to suggest that Underwood be kept on only as artistic advisor. In his letter to Chorley of February 4th, 1954, Lillie wrote that even Fabian was "in favor of cutting clean with Underwood" but Lillie was not in full agreement on this point, noting "I feel that this move would deserve very serious consideration unless we could expect some cooperation from him (Underwood) when necessary until the completion of the job". Removing Underwood from his current position would have required yet another adjustment to his contract, which no one was willing to pursue. Thus, it became clear that a meeting of all parties was needed to work out details to ensure construction would be completed on time.

²⁰³ Harold P. Fabian to Kenneth Chorley, January 16, 1954, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

²⁰⁴ Raymond Lillie to Kenneth Chorley, February 4, 1954, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

Such a meeting took place in New York on February 18th, 1954.²⁰⁵ Present at the meeting were Underwood, Harold Fabian, Raymond Lillie, Paul Wise, Murray Burns, and Allston Boyer. The results of the meeting were outlined in a letter from Boyer to Kenneth Chorley the following day. As of this date, all of the timber structures had been completed, including five dormitories, one recreation hall, three double staff houses, one double staff house for the manager and winter caretaker, and 256 rooms in the guest cottages. As for the central lodge, the structural frame was completed to a point just south of the lounge and the boiler room was finished. An analysis of the unexpected costs encountered in the past year was also discussed and included the trouble with the foundation soil, the many changes in the heating system, and the fact that the Park Service had not provided a water supply system as they had promised, which required the contractor to bring water to the construction site themselves. Once again, the kitchen was cited as being a central cause of elevated costs and delays, but everyone agreed that this could not have been foreseen at the outset and so all modifications were deemed necessary. A redesign of the service area and multiple versions of the lobby were also noted as causes of increased costs. The convention hall and portecochere were kept in the plans, partly because so much had already been ordered and constructed for the hall that it would be just as costly to eliminate it at this stage as it would be to keep it. The final cost of the entire project was expected to be \$4,200,000. Although everyone was very cordial and the meeting was considered quite productive, Mr. Burns made a point of noting that never before in his career had he needed to request additional funds for a project. He felt that if all that was discussed at this meeting had been decided

²⁰⁵ Allston Boyer to Kenneth Chorley, February 19, 1954, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

from the beginning, his estimate would have been \$4,200,000 from the start and that much of the difficulty of making estimates over the past year could have been avoided.

Things seemed to be back on track following the New York meeting, at least through April when the central lodge was about 60% complete.²⁰⁶ However, it seemed that Underwood was becoming increasingly frustrated with the work of the contractor and felt as though decisions were being made behind his back. In a surprisingly aggressive letter on April 27, 1954 to Ray Lillie, Underwood refused to accept any drawings by George Richardson, even though he had agreed to do so in February at the meeting in New York. He became convinced that the electrical subcontractor could not be trusted because he was also the vendor of the electrical materials. Underwood went so far as to write "I do not intend to excuse the Contractor for the abominable work he has done...I want the record to show the futile effort I made to get him to do the work properly...he is the worst contractor I have ever dealt with...I will not be masochistic enough to put approval on the cute tricks of the Contractor to build a shabby job and to set himself up as the architect and engineer"²⁰⁷. Both Ray Lillie and Paul Wise were shocked to read Underwood's comments, as it was unclear what could have prompted such anger. There was no evidence in the correspondence that supported Underwood's claims of poor workmanship. Paul Wise only responded that work was being done in accordance with the plans and agreement made at the New York meeting. Further, he wrote that he had to spend four days getting Underwood's drawings to match

²⁰⁶ Morrison-Knudsen, "The EM-Kayen Magazine of M-K", April, 1954, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

²⁰⁷ Gilbert Stanley Underwood to Raymond Lillie, April 27, 1954, Folder 338, Box 29, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

the agreements made in New York.²⁰⁸ Underwood's letter was an abrupt change in tone from even a few months prior, when he had expressed how pleased he was to be collaborating with George Richardson.²⁰⁹ However, it was also not the first time that Underwood had had a falling out with his contractor. The construction of the Ahwahnee Hotel was also plagued by multiple changes, ever rising costs, delays, an inability of Underwood to submit completed drawings on time and a suspicion on his part that the contractor was completely incompetent.²¹⁰

Although Underwood retracted his aggressive statements in a letter to Ray Lillie on May 11th, his confidence in the contractor was lost and he again emphasized his dedication to integrity, writing "If you (Lillie) knew more about me, you'd find I have a reputation for cooperation with everybody. I have a reputation for integrity also that is more important to me than getting along with a contractor who forgets that the owner is the important person in any job and that the job lives a hell of a long time after we are gone". Whatever his feelings were about the contractor, Underwood agreed to focus on the goal of completing Jackson Lake Lodge within budget.²¹¹ Still, it was not a particularly pleasant note on which to end. A summary of the project was described by Kenneth Chorley in a letter to Laurance Rockefeller shortly before the dedication of the Lodge. In it, Chorley explained how the relationship between Underwood and Morrison-Knudsen had deteriorated over the course

²⁰⁸ Paul Wise to Raymond Lillie, May 8, 1954, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

²⁰⁹ Gilbert Stanley Underwood to George Richardson, November 24, 1953, Folder 346, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

²¹⁰ Joyce Zaitlin, *Gilbert Stanley Underwood: His Rustic, Art Deco, and Federal Architecture*, (Malibu: Pangloss Press, 1989), p. 62-70.

²¹¹ Gilbert Stanley Underwood to Raymond Lillie, May 11, 1954, Folder 166, Box 14, Underwood Correspondence 1954 series, Record Group Jackson Lake Lodge, Grand Teton Lodge Company Collection, RAC.

of the construction because of the pressure placed on Underwood working alone. Without a team to support him, Underwood quickly fell behind in producing drawings and Morrison-Knudsen eventually insisted on taking over the mechanical, heating, and electrical plans. Underwood's delays were not the only problem. He frequently sent updated drawings that included a number of new items and changes to work already completed. The result was confusion and frustration on the part of the contractor and a belief on the part of the architect that the contractor was incapable of following his instructions. Not only were relations between the two hostile by the end, but the development was completed about five months later than expected.

Jackson Lake Lodge was dedicated on June 11, 1955 and in July of 1956 the tourist center hosted one of its first conventions. According to the "convention issue" of *The Broadcaster*, the magazine of Bankers Life Insurance Company of Nebraska, a large group of employees and their families were among the first to enjoy all that Jackson Lake Lodge had to offer. A multi-page spread illustrated the convention highlights.²¹² Between 1956 and 1961, Jackson Lake Lodge operated at full capacity and became a very popular destination. Meetings of the Board of Directors of the Grand Teton Lodge Company (GTLC) were held at least once a year during this time. One of the first items reviewed for approval by the Board was a proposal to increase the Lodge's capacity by 300 rooms. This proposal was rejected, but another one for an increase of 100 rooms was accepted, based on data from the 1955 and 1956 seasons,

²¹² Bankers Life Insurance Company of Nebraska, *The Broadcaster*, July 1956, Folder 833, Box 90, Cultural Interest Series, Record Group 2 OMR, RFA, RAC.

during which Jackson Lake Lodge was operating at about 95-99% capacity and was turning away significant numbers of potential guests.²¹³

Other changes that were made soon after the Lodge opened included the widening of the main stairway by Olsen Construction Company, the installation of a new dumbwaiter (to replace one that had hardly worked since the Lodge's opening), and the elimination of the service bar in the dining room (all completed in 1957).²¹⁴ In 1958, the space beneath the Explorer's Room was converted from a convention display space to additional meeting rooms and a place for outdoor events to be moved in inclement weather.²¹⁵ In 1960, new windows were installed in all of the guest rooms in the central lodge, effecting a significant change in the aesthetic of the exterior.²¹⁶ Over the next 50 years, nearly all of the windows would be changed, in size, glazing type, or both. In 1961, a fire destroyed the Explorer's Room, prompting a thorough investigation of fire prevention methods and the application of the fire-resistant coating Albi-r [™] in areas deemed to be at the highest risk for damage by fire.²¹⁷

²¹³ Grand Teton Lodge Company, *Minutes of the Meeting of the Board of Directors*, p.18-21, September 8-9, 1956, Folder 354, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC.

²¹⁴ Grand Teton Lodge Company, *Minutes of the Meeting of the Board of Directors*, p.25, September 16-17, 1957, Folder 354, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC

²¹⁵ Grand Teton Lodge Company, *Minutes of the Meeting of the Board of Directors*, p.27-30, September 5, 6, 7, 1958, Folder 354, Box 30, Family Related Individuals series, Record Group 7.2 HPF Papers, Special Collections, RAC

²¹⁶ Grand Teton Lodge Company, *Minutes of the Meeting of the Board of Directors*, p.41, 1960, Folder 829, Box 90, Cultural Interest Series, Record Group 2 OMR, RFA, RAC.

²¹⁷ Grand Teton Lodge Company, *Minutes of the Meeting of the Board of Directors*, p.13, 1960, Folder 829, Box 90, Cultural Interest Series, Record Group 2 OMR, RFA, RAC.

In 1976, the dining room at Jackson Lake Lodge (known as the Mural Room after the installation of artwork by Carl Rotors in 1958) was altered. A new host desk was constructed and small service bars were reintroduced at the south end of the room. Air conditioning was also introduced to the space at this time. The next major change to the central lodge came in 1988, when the Blue Heron Bar was added to the northwestern corner of the central lodge. Until this time, the Grand Teton Lodge Company had been operating as a non-profit organization funded by the Rockefeller family. In 1986, the Rockefellers sold the Lodge Company to CSX Corporation, a for-profit, Virginia-based transportation company.²¹⁸ With this change came the need for more revenue-producing areas in the central lodge. Therefore, the Stockade Bar that once opened onto the Sun Deck was converted into retail space and the bar was moved to the west side of the lodge, opening as the Blue Heron Bar.

The years 1989 and 1991 saw changes in the ground floor lobby. A new interior design scheme was implemented and new offices were constructed along the north wall. The new exterior wall and windows were designed in manner that was sensitive to the original fenestration and Shadowood molded concrete. The guest rooms in the central lodge have undergone several renovations over the past 50 years, but this report only had access to documentation for changes made in 1992. In 1998, the Explorer's Room was expanded to create more break-out room spaces on the east side of the convention hall. Changes were made to the gift shop to accommodate a new corridor in between the main convention hall and the new break-out rooms. A major renovation of the Mural Room took place in 2002.

²¹⁸ CSX Corporation, "A Short History of Jackson Lake Lodge, A CSX Resort" (Richmond: CSX Corporation, 1997), 9.

Other small changes to the central lodge include the addition of an enclosure for refuse in the service yard in 1998, the installation of new egress and fire stairs in 2004, and the removal of carpeting in the lower lobby in 2007.

In addition to the changes to the fenestration, the other major alteration to the exterior of the central lodge was a re-coloring of the concrete in 2000. After being exposed to the elements for nearly 50 years, the concrete had achieved the weathered look desired by the architect, but perhaps appeared too uneven and faded for the lodge owners. The concrete was acid etched, power washed and mechanically scrubbed before being coated with another colored stain, probably water-based. The new color was a uniform, reddish-brown that gave the building a very warm, earthy tone. In the past 15 years or so this new coloring has also weathered, and in many places has lightened unevenly and become streaky. Another coloring campaign is expected to take place in the next few years.

Even though its appearance was derided when it first opened, these objections have not prevented thousands of people from taking advantage of all that the Lodge has had to offer every season for the past 50 years. While significant differences exist between Underwood's original design intention and the current appearance of Jackson Lake Lodge, the ways in which visitors interact with building has remained the same. The stunning view of the Grand Teton range still has the power to surprise and awe visitors, even if they are no longer drawn through dark, tunnel-like space to reach the Upper Lobby. The Pioneer Grill retains its 1950s diner charm, while the Mural Room offers another way to enjoy Jackson Valley. The Blue Heron Bar takes full advantage of its west elevation location and provides a welcome rest for thirsty conference attendees after a long day in the Explorer's Room.

Despite many changes, Jackson Lake Lodge retains much of its historical integrity and is still one of the earliest and most significant works of Modernist architecture in the National Parks.

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